



To Pandemic or Not? Reconfiguring Global Responses to Influenza

Paul Forster

Pandemics

A large, abstract graphic consisting of several thick, overlapping curved lines in shades of green and grey, filling the bottom half of the cover.

To Pandemic or Not? Reconfiguring Global Responses to Influenza

Examining the political economy of knowledge in responses to the 2009-10 influenza pandemic, this paper argues that globally, and in many individual nations, techno-scientific narratives constructed by bio-medical actor networks failed to correspond with the more variegated narratives of multifarious global publics, and so struggled to recruit support and maintain credibility and authority. With reductive narratives constructed by bio-medical actor networks confounded by the uncertainties intrinsic to the influenza virus, the complexities of the disease in individuals, and compromised by continuing ignorance, political and cultural forces became dominant.

Universalistic, one-size-fits-all responses drawn from reductive science are therefore argued to be insufficient, and possibly misguided. Planning and response efforts must consider diverse local settings and concerns. Reductive technical framings emerging from tight, unreflexive actor networks may prevent other options from emerging, and limit response pathways. Such narrow, technocratic responses are not only at odds with the varied understandings, needs and priorities of different people in different parts of the world, but also favour rich, industrialised nations.

In conclusion the paper argues that the world would be better protected by a re-ordering of pandemic preparedness and response efforts around the needs of the world's poorest, most vulnerable, and most exposed people. A re-ordered response would allow the undue pre-eminence of pharmaceuticals to be examined, and bring into focus the pressing need for disease surveillance in animals, along with scrutiny of contemporary agricultural practices. A re-ordered response might also refresh the World Health Organization, which currently supports an inflexible and narrow set of interests by default rather than conspiracy, and encourage a broadening of research efforts.

Preparing for an influenza pandemic means preparing for surprises and being ready to respond rapidly and flexibly under conditions of uncertainty. If people everywhere are to be engaged, plural and diverse response pathways are required.

About the Author

Paul Forster is an independent development consultant concerned with public policy making and social justice. His current work focuses on the socio-ecological dynamics of disease, particularly zoonoses and epidemics, in the context of risk, resilience, livelihoods and global health governance. His professional interests lie in applying interdisciplinary methods to real world development challenges, the politics of knowledge, and the dynamics of 'global' and 'local' processes. Paul has BA and MA degrees in Philosophy, Psychology and Physiology from Oxford University, and a DPhil in Development Studies from the Institute of Development Studies at Sussex University.

About the STEPS Centre

Today's world is experiencing rapid social, technological and environmental change, yet poverty and inequality are growing. Linking environmental sustainability with poverty reduction and social justice, and making science and technology work for the poor, have become central challenges of our times. The STEPS Centre (Social, Technological and Environmental Pathways to Sustainability) is an interdisciplinary global research and policy engagement hub that unites development studies with science and technology studies. We are developing a new approach to understanding and action on sustainability and development in an era of unprecedented dynamic change. Our pathways approach aims to link new theory with practical solutions that create better livelihoods, health and social justice for poor and marginalised people. The STEPS Centre is based at the Institute of Development Studies and SPRU Science and Technology Policy Research at the University of Sussex, with partners in Africa, Asia and Latin America. We are funded by the ESRC, the UK's largest funding agency for research and training relating to social and economic issues.

www.steps-centre.org.

Follow us on Twitter [@stepscentre](https://twitter.com/stepscentre)

Other titles in this series include:

- | | |
|-----------------------|--|
| Approach | Pathways to sustainability: an overview of the STEPS Centre approach |
| 1. Dynamics | Dynamic Systems and the Challenge of Sustainability |
| 2. Governance | Understanding Governance: pathways to sustainability |
| 3. Designs | Empowering Designs: towards more progressive appraisal of sustainability |
| 4. Agriculture | Agri-Food System Dynamics: pathways to sustainability in an era of uncertainty |
| 5. Health | Health in a Dynamic World |
| 6. Water | Liquid Dynamics: challenges for sustainability in water and sanitation |

For more STEPS Centre publications visit:

www.steps-centre.org/publications

This is one of a series of Working Papers from the STEPS Centre
www.steps-centre.org.

ISBN: 978-1-78118-085-3

Price £5.00

© STEPS 2012



To pandemic or not?
Reconfiguring global responses to
influenza

by Paul Forster

Correct citation: Forster, P. (2012) *To Pandemic or Not? Reconfiguring Global Responses to Influenza*, STEPS Working Paper 51, Brighton: STEPS Centre

First published in 2012

© STEPS 2012. Some rights reserved – see copyright license for details

ISBN: 978-1-78118-085-3

Acknowledgements: Thanks are due to all those who agreed to be interviewed in the research phase of this paper, or contributed in other ways, and to Paul Gully, Olga Jonas, Melissa Leach and Ian Scoones who helpfully commented on working drafts. Needless to say, all errors and omissions remain the responsibility of the author. Design by Wave (www.wave.coop), Barney Haward and Lance Bellers. Print by MCR Print (www.mcrprint.co.uk).

For further information please contact:

STEPS Centre, University of Sussex, Brighton BN1 9RE

Tel: +44 (0) 1273915673

Email: steps-centre@ids.ac.uk. Web: www.steps-centre.org

STEPS Centre publications are published under a Creative Commons Attribution – Non-Commercial – No Derivative Works 3.0 UK: England & Wales Licence (<http://creativecommons.org/licenses/by-nc-nd/3.0/legalcode>)

Attribution: You must attribute the work in the manner specified by the author or licensor.

Non-commercial: You may not use this work for commercial purposes.

No Derivative Works: You may not alter, transfer, or build on this work.

Users are welcome to copy, distribute, display, translate or perform this work without written permission subject to the conditions set out in the Creative Commons licence. For any reuse or distribution, you must make clear to others the licence terms of this work. If you use the work, we ask that you reference the STEPS Centre website (www.steps-centre.org) and send a copy of the work or a link to its use online to the following address for our archive: STEPS Centre, University of Sussex, Brighton BN1 9RE, UK (steps-centre@ids.ac.uk).



Contents

Abstract	1
1. Introduction	2
2. What's in a name?	9
3. What's a pandemic?	16
4. Why pharmaceuticals?	29
5. Whose world? Whose health?	39
6. Conclusion: publics and health	49
Annexes	52
References	55

Abstract

Examining the political economy of knowledge in responses to the 2009-10 influenza pandemic, this paper argues that globally, and in many individual nations, techno-scientific narratives constructed by bio-medical actor networks failed to correspond with the more variegated narratives of multifarious global publics, and so struggled to recruit support and maintain credibility and authority. With reductive narratives constructed by bio-medical actor networks confounded by the uncertainties intrinsic to the influenza virus, the complexities of the disease in individuals, and compromised by continuing ignorance, political and cultural forces became dominant.

Universalistic, one-size-fits-all responses drawn from reductive science are therefore argued to be insufficient, and possibly misguided. Planning and response efforts must consider diverse local settings and concerns. Reductive technical framings emerging from tight, unreflexive actor networks may prevent other options from emerging, and limit response pathways. Such narrow, technocratic responses are not only at odds with the varied understandings, needs and priorities of different people in different parts of the world, but also favour rich, industrialised nations.

In conclusion the paper argues that the world would be better protected by a re-ordering of pandemic preparedness and response efforts around the needs of the world's poorest, most vulnerable, and most exposed people. A re-ordered response would allow the undue pre-eminence of pharmaceuticals to be examined, and bring into focus the pressing need for disease surveillance in animals, along with scrutiny of contemporary agricultural practices. A re-ordered response might also refresh the World Health Organization, which currently supports an inflexible and narrow set of interests by default rather than conspiracy, and encourage a broadening of research efforts.

Preparing for an influenza pandemic means preparing for surprises and being ready to respond rapidly and flexibly under conditions of uncertainty. If people everywhere are to be engaged, plural and diverse response pathways are required.

1. Introduction

The virus writes the rules and this one, like all influenza viruses, can change the rules, without rhyme or reason, at any time.¹

In mid-April 2009, a novel human influenza virus was detected in Mexico and California, which quickly spread around the world. On 29 April 2009, the United Nations World Health Organization (WHO) declared 'phase 5' in its predetermined pandemic alert scale (see Annex 1), announcing the first influenza pandemic since 1968, and by 10 June, 74 countries had reported over 27,000 confirmed cases, including 141 deaths (WHO 2009b). At the time, US projections suggested that virus could infect between one-third and one-half of the national population and kill as many as 90,000, with children and young adults most badly affected (PCAST 2009: viii). In the UK, 65,000 deaths were predicted as a worst-case scenario.² Some 15 months later, on 1 August 2010, more than 214 countries worldwide had reported cases, including over 18,449 laboratory-confirmed deaths from an estimated 600,000 human infections (WHO 2010a). This was fewer than would be expected as a result of seasonal influenza, which occurs every year, although the true number of deaths could be significantly higher.³ On 10 August, WHO announced the end of the pandemic, and the beginning of the 'post-pandemic phase' (WHO 2010c).

Nine months before this announcement, and largely in reaction to the perceived mildness of the event, vocal criticism emerged in Europe claiming that the Emergency Committee advising WHO had been subject to undue commercial influence which had led to the declaration of a 'false pandemic' in order to sell vaccines and anti-viral drugs to the benefit of pharmaceutical companies. Wolfgang Wodarg, a medical doctor who chaired the Council of Europe's health committee suggested that US\$18 billion had been wasted, and that WHO's actions were 'one of the greatest medical scandals of the century' (The Week 2010). These claims were taken up by the British Medical Journal in particular (Cohen and Carter 2010), and have led to unprecedented criticism of WHO's handling of the event, an extensive review by WHO, and unusual scrutiny of the H1N1 response by many governments.

This was not the first time a novel H1N1 Influenza A virus caused alarm and controversy. In 1976, a similar virus provoked a massive public health response in the USA, including plans to vaccinate the entire US population, but also failed

¹ WHO Director-General Dr Margaret Chan in an 11 June 2009 press statement (WHO 2009g).

² Sir Liam Donaldson, UK Chief Medical Officer, quoted in The Independent, 17 July 2009.

³ Dawood *et al.* (2012) estimate that there were 201,200 respiratory deaths and 83,300 cardiovascular deaths of which half occurred in south-east Asia and Africa.

to develop as expected. A report was subsequently commissioned by the then US Secretary of State of Health, Education, and Welfare: 'The Swine Flu Affair: Decision-Making on a Slippery Disease' (Neustadt and Fineberg 1978). The report identified seven key elements in policy making associated with the 1976 events:

- Overconfidence by specialists in theories spun from meagre evidence.
- Conviction fuelled by a conjunction of some pre-existing personal agendas.
- Zeal by health professionals to make their lay superiors do right.
- Premature commitment to deciding more than had to be decided.
- Failure to address uncertainties in such a way as to prepare for reconsideration.
- Insufficient questioning of scientific logic and of implementation prospects.
- Insensitivity to media relations and the long-term credibility of institutions. (p.1)

The report also highlighted two policy issues. First, how should politicians and non-expert officials address matters that depend on complex and technical, but speculative and incomplete, expert knowledge? Second, how should the public be involved in such matters, and how can they be debated given the type of complicated and technical issues at play? (p.iii)

These issues appear to remain relevant today, even given the experience of HIV/AIDS, SARS and H5N1 avian influenza. Influenza is still a 'slippery' disease causing a wide range of symptoms, from which there is no way to protect a population as individual resistance or vaccination provide only temporary stops in the face of constant viral mutation and re-assortment. The virus, and the disease, also still have the ability to confuse and confound us. Not only was the 2009-10 event milder than anticipated - apart from the first wave of illness in Mexico in April 2009, and some individual local outbreaks - but the virus, an 'unusually mongrelised' mix of genetic sequences from North American pigs, Eurasian pigs, birds and humans, emerged in the Americas rather in east and south-east Asia, where global attention had focused since 1997 when a H5N1 virus caused 18 recorded human cases and six deaths in Hong Kong and then spread widely in birds (Doerr *et al.* 2009; MacKenzie 2009). Now, as then, influenza presents scientists, public health policy makers and people worldwide with a confounding mix of uncertainty, complexity and politics. Now, perhaps even more than in 1978, these issues are amplified by increasingly critical and reflexive publics, and intensive mass media.

Power, politics and pathways

This paper does not present such an exhaustive, geographically-focused, investigation as that of the Neustadt and Fineberg report. Instead, drawing on previous STEPS Centre research into the social, ecological, biological and institutional dynamics of disease, it examines the global response focusing on the political economy of knowledge. To this end, it investigates and analyses the narratives - the persistent storylines - involved in the 2009-10 H1N1 pandemic, their interactions, and the dominance of certain narratives at the expense of others (cf. Keeley and Scoones 2003; Scoones and Forster 2008; Dry and Leach 2010). Narratives are important because they illuminate the different actor networks involved and elucidate how different pathways of responses are created, shaped and justified. Different socially and politically positioned actor networks bring different assumptions, forms of knowledge and values to a problem, resulting in different framings of how it is bounded and understood.

Critically, this puts the power dynamics involved in political and institutional relationships centre-stage: the framings and resultant narratives of more powerful actors and institutions, possibly with biased or entrenched interests, may exclude, suppress or obscure those of less powerful actors with different knowledges, values and objectives. This approach is well-suited to an investigation concerned with the contestations and confusions associated with the interactions of scientific and social domains (Callon 1986; Law 1986; Callon 1991). The success of policy ideas is assumed not to be inherent in their design, but to arise from their ability to continue recruiting support and so impose a growing coherence on those who argue about them or oppose them (Latour 1996). By examining a plurality of framings and narratives, the paper intends to stimulate reflection and discussion about how the influenza pandemic threat is best addressed, with the objective of broadening and opening debate, and developing more effective, equitable, accountable and resilient global health systems.

This paper does not reiterate previous STEPS Centre analyses of epidemics and epizootics. These have already identified an 'outbreak' narrative, which 'begins with the identification of an emerging infection, including discussion of the global networks throughout it travels, and chronicles the epidemiological work the ends with its containment,' as being key in the mobilisation of significant global concern and resources (Wald 2008: 2). Such a framing may unhelpfully over emphasise the 'discovery' of a novel pathogen, and over prioritise a centralised, emergency response directed at eradication, leading to the occlusion of underlying factors driving disease emergence such as the intensification of agriculture, or changes in human settlement patterns. Nor does this paper address the effects of changes in mass communications and news reporting over the last two decades. Increased internet use - both to provide and to access information - and shorter news cycles have arguably led to more reflexive and critical public responses.

Inevitably, this paper focuses to a large degree on the actions of WHO in the context of a 'global health security' narrative. This emphasises dangers emerging from a globalising world, increasingly interconnected by trade and travel, which threaten industrialised nations (Fidler 1996; Heymann 2006; McInnes and Lee 2006). By definition a pandemic is a cross-border event of the type that falls at the heart of WHO's mandate, and theoretically at least, the international governance of public health has never been more tightly integrated, with WHO at its core. The 2005 revision of the 1969 International Health Regulations (IHR) signalled a tectonic shift, with a ceding of national sovereignty in the face of any global health threat (Baker and Fidler 2006; Fidler and Gostin 2006). In the case of pandemic influenza, this sets WHO centre-stage and spot-lit, significantly separate from the other large groups such as Global Fund to Fight AIDS, Tuberculosis and Malaria, and the Rockefeller and Gates foundations, which are increasingly involved in global health issues (Brown *et al.* 2006).

As one major strand of global thinking moves to a 'whole-of-society' approach, incorporating pandemic preparedness into a more generic disaster preparedness model (cf. PREVENT Project 2011), and as individuals are increasingly called upon to take responsibility for their own safety (cf. IFRC 2009), this paper asks if the issues Neustadt and Fineberg identified are in 1978 are still relevant. Is the world now better prepared to respond to flu, and if not, why, and how might it be? How should national and supranational institutions respond to threats such as influenza, where the science is so uncertain, and the population so nervous?

Paper structure

Following this introduction, the paper, which draws on a review of academic literature, policy papers and media reports, and 33 non-attributable interviews with actors and observers involved in the events of 2009-10, offers four sections and a conclusion. The next section examines the confusions and contestations that swirled around the naming of the virus and the event. This issue elucidates the major actor networks involved, contrasting those focused on science and biomedicine, which sought a technically accurate and politically neutral term, with the mass media and the public, which were less concerned about accuracy and neutrality, and more inclined towards a name that was tangible and memorable. Elite technical framings are shown to be inflexible and lack correspondence with popular framings and so fail to recruit support and consequently lose authority and credibility. The naming issue also illuminates efforts by an elite actor network involved with industrialised meat production to suppress an important narrative concerning the involvement of animals and farming practices in generating and transporting novel flu viruses. This demonstrates the influence of commercial and political forces when technical credibility fails, and inhibits surveillance for novel viruses in animals, a fundamental element of the world's ability to address the threat of pandemic influenza.

The third section investigates more turbulent issues associated with the definition of the key term of the event - 'pandemic'. The WHO's announcement to move to 'phase 5' of the organisation's predetermined 1-6 pandemic alert scale, which signalled officially that a pandemic was underway, but which took no account of the severity of the illness resulting from the virus, was a major focus of the unprecedented criticism levelled at the organisation. This criticism, which emerged most vocally from a European political network, serves as further illustration of the gap between technical and popular framings during the 2009-10 event, and offers further insight into why the former was challenged in recruiting popular support. Effectively responding to flu involves addressing issues of complexity and diversity as well as uncertainty, which the reductive framing of scientific biomedicine is ill-equipped for. At the centre of an elite actor network driving and drawing on unreflexive, reductive techno-scientific narratives, WHO is in a weak position to provoke or manage change.

The fourth section focuses on the dominance of pharmaceuticals in the scientific bio-medical response. In 2009-10, vaccine and anti-viral drugs were central to many governments' plans for preventing influenza deaths and limiting the speed of spread, and the event was a bonanza for pharmaceutical companies producing them. Yet vaccine arrived late, uptake was low, and scientific and public doubts quickly emerged regarding the efficacy and safety of anti-viral drugs. The overlapping attractiveness of an epistemologically reductive framing to normative institutions charged with governing public health - globally and nationally - and commercially driven pharmaceutical industry actors, creates one set of challenges: inappropriate collusions are easily drawn. A more serious set of challenges, central to a more effective response to flu, are created by the suppression of alternative and complementary responses. Again a universalistic approach is disrupted by the variegated concerns of individuals, which further undermines the credibility of institutions advocating it.

The fifth section considers the implications of a dominant reductive technocratic approach, which derives from and favours high-income populations and commercial interests in the global North, in the context of the needs of the world's poorest and most vulnerable people. Little is known about flu in the tropics, where low-income countries suffer persistently the burden of more deadly and debilitating diseases. A narrow, technical construction of the pandemic threat, and the response to it, is therefore easily construed as misapplication of attention, funding and effort by WHO on behalf of the countries that most significantly fund it. During the 2009-10 event, given even the best of normative intentions, underpinned by a pressing political imperative, North-South equity in the response was elusive. Surveillance systems, pharmaceuticals provision, medical care and public, non-pharmaceutical responses were all shown to be more effective in high-income countries.

The conclusion suggests that the world would be better protected from flu by a re-ordering of pandemic planning and preparedness efforts around the needs and

means of the world's most vulnerable and exposed people. The current reductive response configuration, which has changed little since the 1970s, is confounded by the uncertainty inherent in the influenza virus, confused by the complexities of the disease in individuals, and compromised by continuing ignorance regarding both, and the mix of them. Unresponsive to popular concerns, and so losing credibility and authority, the current configuration both generates and maintains dangerously narrow response pathways, which are inappropriate and insufficient in the face of uncertainty, and inhibit the development of alternatives.

A re-ordered response would allow the pre-eminence and use of pharmaceuticals to be examined, and bring into focus the pressing need for improved disease surveillance in animals, along with wider considerations of contemporary agricultural practices. It would also refresh and refocus WHO, which supports current working practices by default rather than conspiracy, and broaden research efforts. If people are to be engaged in preparing for and responding to influenza pandemics, variegated and plural responses appropriate to location, and driven by local needs, are essential.

Flu in the news

Little of the post pandemic analysis, which was extensive, has addressed the event critically, in terms of knowledge and power. Much of it, created by and for a scientific, business and policy elite is laudatory. In an editorial, *Nature* (2010) suggested that the event had been a useful dry run for a more severe pandemic, pointing positively to quick responses by national and international agencies, and open sharing of data on the genetics, virology and epidemiology of the virus. The Council of the European Union (2010) commended 'the rapid and robust response' of the Member States, the European Commission, the European Centre for Disease Prevention and Control (ECDC), the European Medicines Agency (EMA) and WHO. In the USA, the response was described as 'excellent' and 'B-plus' by the *New York Times*, which noted that relatively cautious decisions by the nation's medical leadership had contained the pandemic with minimal economic disruption, and that the many rumours that had arisen were quickly debunked (McNeil 2010). Canada too considered it had managed the event well, and essentially called for more of the same, albeit scalable to mild, moderate and severe pandemics, along with renewed funding for pandemic preparedness, a backup supplier for vaccine, and increased involvement of pharmacists and paramedics (Canadian Senate Committee on Social Affairs Science and Technology 2010). The UK's Hine Report was also largely congratulatory, noting sound preparations and a 'proportionate and effective' response (Hine 2010: 3).

Nevertheless, even from the perspective of the well prepared global North, it is salutary to note that a detailed review of the 2009-10 event for WHO concluded that: 'The world is ill-prepared to respond to a severe influenza pandemic or to any similarly global, sustained and threatening public-health emergency', and an article in an influenza-themed edition of WHO's *Bulletin* presents a detailed

two-page table listing failures in just the European response (WHO 2011b: 12; Nicoll *et al.* 2012). These include: weaknesses in core preparedness capacities, inadequate regional coordination and cooperation, differing and sometimes conflicting national responses, lack of flexibility of vaccine procurement contracts, and suboptimal effectiveness of influenza vaccines.

The Lancet (2010: 565), in a generally positive editorial, highlighted the ‘familiar division between the haves and have-nots’ resulting from the concentration of vaccine production facilities in the developed world, the low demand for vaccine in high-income countries, the need for agreed advance protocols to cover trials of treatment strategies, and the challenges to expert credibility posed by the disparity between the predicted and the actual severity of event. Elsewhere, other critical observations included: late delivery of too little vaccine following too optimistic predictions, little viral surveillance in pigs, poor human serological surveillance, public confusion between planning assumptions and event predictions, the reliance of politicians on scientific advice, and the fact that in some places healthcare facilities were pushed to their limits. Common calls for improvements included: better communication with the public and healthcare personnel, research independent from pharmaceutical companies, and faster monitoring and reporting of events. The danger that a relatively mild pandemic might create a false sense of security and complacency was also noted.

It is unfortunate that these detailed analyses have largely been occluded by the charges of over-reaction and inappropriate commercial collusion made against WHO. Similarly, accusations that many national governments squandered large sums of money on unwanted pharmaceutical supplies have diverted attention from more serious matters. During the 2009-10 event, few high-income countries were prepared to place global solidarity before the political imperatives of protecting their own populations. The technology also failed: health systems were stretched in even the richest and best equipped countries, surveillance was quickly abandoned, the benefits of anti-viral drugs remained unproven, and when vaccines arrived, uptake was low.

This paper has examined these cracks with a view to explaining why they arose, and how similar fractures might be avoided in the future. What does this ‘false pandemic’ mean for the global authority and credibility of WHO? Why did the authorities - global and national - get into such a tangle in 2010, and how is a repeat best avoided? The next section picks up these questions in the context of what should have been the most simple of matters: the naming of the virus and the event.

2. What's in a name?

On naming, I'd say that we need something between a popular name and a technical name. There's a need to be as correct as possible whilst also being accessible. So 'swine flu' does not really do it; 'Mexican flu' was never going to fly. Me, I rather like the sound of 'La Gloria flu'... I thought that had a ring to it.⁴

Pigs and politics

The first official situation update concerning the 2009-10 pandemic from WHO's Global Alert and Response (GAR) unit on 24 April 2009, reporting US confirmation of seven human cases in California and Texas, and the confirmation (by laboratories in Canada) of 18 cases in Mexico (dating back to 18 March) of which 12 were genetically identical to the viruses from California, made explicit reference to 'swine influenza A/H1N1' (WHO 2009f).⁵ This terminology however only continued in official updates, and at WHO press conferences, for five days. The fifth GAR update on 29 April 2009 adopted the headline 'Influenza A(H1N1)', and by the sixth, a day later, the term 'swine' had been expunged from WHO statements, and an announcement, which would become a regular part of WHO communications, was introduced stating that there was no risk of human H1N1 infection through the consumption of well-cooked pork products (WHO 2009e).⁶

In this brief period, a set of objections to the use of the term 'swine' in the naming of the virus and the event had emerged from a number of powerful actor networks. In the USA, the meat industry had strongly objected, and according to one respondent, were quick to make representations:

I've heard that the US pork lobby got straight on the phone to the White House and then the White House called WHO and in no uncertain terms told them to drop it. Obama went on TV too, and pointedly called it H1N1, not swine flu. You can see why. Once it was in a human population, swine had nothing to do with it, and it's well known now how sensitive people are to food scares. It could have cost the US pork industry millions.⁷

Subsequently, as many countries, including Russia, China, Ukraine, Kazakhstan, the Philippines, Thailand, the United Arab Emirates and Serbia, made moves

⁴ Interview, Geneva 23 February 2012b

⁵ This report also noted Mexican concern over an unusually high number (854) of pneumonia cases in Mexico City, of which 59 were lethal.

⁶ The 'swine flu' term is however still embedded in the URLs of WHO's web site, e.g. <http://www.who.int/csr/disease/swineflu/en/> [accessed 5 February 2012].

⁷ Interview, Davos, 21 February 2012c

to restrict the import of Mexican and US pork products, and Egypt's parliament discussed radical plans to cull all of the country's estimated 300,000 pigs (Tadroz 2010), in the USA at least, official nomenclature settled on 'Influenza A (H1N1)'.

In the same vein, and with similar ambitions of supporting trade, on 28 April the World Organisation for Animal Health (OIE) in Paris stated that as the virus had not been isolated in pigs, and as it included genetic components of human, avian and swine origin, the swine nomenclature was inaccurate (OIE 2009). Stressing that influenza in swine is not a reportable disease according to the OIE Terrestrial Animal Health Standards Code, and that consequently there was no justification for the imposition of trade controls on the importation of pigs or their products, the organisation proposed that the event be referred to as 'North American influenza', drawing on an informal convention that had set geographical references in the names of the three pandemics of the previous century: 'Spanish flu' (1918-20), 'Asian flu' (1957-58) and 'Hong Kong flu' (1968-69).⁸

Similarly, the UN Food and Agriculture Organization (FAO) also agreed to remove 'swine' from the nomenclature, but did not hazard to propose any alternatives (FAO 2009). The OIE's suggestions as to naming went down badly among the other UN agencies, in particular WHO. Severe acute respiratory syndrome (SARS) had been carefully named in 2003 so as to not stigmatise any country or region,⁹ and in 2007, according to one respondent, WHO had formed a special group at China's behest to remove geographical references from even from the technicalities of influenza virus clade names.¹⁰ The 2009 naming issue had already caused one diplomatic spat when Israel's health minister objected to the term 'swine flu' on the grounds of Jewish and Muslim sensitivities, and proposed the name 'Mexican flu', a suggestion that provoked outrage from Mexico's ambassador to Israel. Other unfortunate consequences of the 'swine' nomenclature included Kuwaiti health officials suggesting that the country was unlikely to experience human cases as it had no pig farms (Philidor 2009).

Subsequently on 30 April, the three main UN agencies - WHO, OIE and FAO - jointly announced that in order to dispel the notion that pigs were to blame for the influenza epidemic, they would remove 'swine' from the virus's name and refer to it as 'Influenza A/H1N1', a term only a couple of parentheses away from that proposed by US officials (CIDRAP 2009). Other agencies and organisations quickly fell in line. These included the US Centers for Disease Control and Prevention (CDC), which had been experimenting with 'swine-origin influenza A

⁸ Whilst 'Asian' flu is commonly believed to have originated in south-west China, and 'Hong Kong' flu was first isolated in Hong Kong, 'Spanish' flu is now most often considered to have originated at a US military facility in Kansas, but was so named as it was first reported in Spanish newspapers, which were uncensored, unlike the press elsewhere in Europe and the USA at the time which was subject to controls continuing from World War I.

⁹ Interview, London 9 February 2012b

¹⁰ Interview, Geneva 23 February 2012b

(H1N1) virus' (or S-OIV for short), and the European Commission, which had initially adopted a vague and time-limited term: 'novel flu virus' (Europa 2009).

More radical voices got little hearing. Several groups suggested that the event should be named 'NAFTA flu', referring to the 1994 North American Free Trade Agreement, which created a free trade zone between Canada, Mexico and the USA. This, it was argued, had encouraged the industrialisation of Mexican pig farming, and the poorly regulated operation of transnational agribusiness concerns there, which had led to conditions favouring viral mutation and human infection (Wallace 2009). Others, more precisely, suggested 'La Gloria flu', deriving the name from the town in Mexico's Veracruz state which had been identified as the probable epicentre of the outbreak. In much of the English-speaking world, however, the term 'Swine flu' has stuck, and in Mexico, the event remained known simply as 'la epidemia' (Enserink 2009).

Naming and blaming

Considering the power dynamics and politics of the event, it should be noted first that first names stick. Having introduced 'swine' into the equation in its earliest announcements, WHO, even with coordinated action from the world's other major human and animal health technical agencies, and considerable impetus from the US lobbying industry, had little effect on popular terminology. Second, the widely reported H5N1 avian influenza epizootic (more popularly known as 'bird flu'), together with a small number of lethal human H5N1 infections, had both primed the international health apparatus for extensive and urgent action, and set animals in the frame as a source of dangerous influenza viruses among popular understandings. If 'bird flu' had not existed, it is unlikely that 'swine flu' would have been so named. Third, the speed and determination with which the pork industry in the USA moved to quash the connection is impressive. Certainly, the novel virus was one of humans, not pigs, but it did contain genetic elements of a swine influenza (as well as an avian influenza), and it was obviously of paramount importance to the pork industry that this connection be obscured. The US National Pork Producer's Council estimated that between 24 April and 1 May the disease cost the pork industry US\$7.2 million a day (Walsh 2009).

The consequences of this occlusion for global health exercised the animal health professionals interviewed for this study more than any other issue. One said:

It's an embarrassment, a global embarrassment that we don't have more swine flu surveillance. We have never seen swine acting so clearly as mixing vessels. But that message has not translated into global action. We have no idea of what's going on with swine in China for example. We are supposed to be engaging in China, but we are not getting anywhere. There's resistance at every level, zero transparency. [...] The fact is that in the last five, ten, twenty years there has been a build up of virus in pigs.

This is bi-directional. Humans are passing the virus to pigs and so there is continual replenishment. Now we see H3N1 popping up in swine every two or three weeks, and the risk of a new pig virus is never as high as it has been today. There's human H1N1 infecting pigs too, and I don't like to think what would happen if H2 starts circulating significantly in pigs.¹¹

In pigs, flu tends to be mild, so there is little economic incentive for surveillance amongst industry or farmers. Surveillance also carries a cost and may damage animals, and with no organisation charged with overall responsibility for flu surveillance in pigs, or birds (WHO focuses entirely on human flu surveillance, and with FAO's mandate directed at food security, OIE is concerned most significantly with animal health in the context of trade), swine flu surveillance is practically non-existent. With some 1 billion domestic pigs in the world, almost half of which are in China, only 7,679 pig flu sequences were sourced between 2003 and 2011, with just three countries - the United States, China and Hong Kong - collecting more than 1,000 swine flu sequences each, and around 200 countries collecting none at all, including Russia, Poland, the Philippines, Denmark and the Netherlands, each home to over 10 million pigs (Butler 2012). The respondent quoted above continued:

H1N1 didn't help. You'd have thought that that would have made the relevance of it [flu surveillance in swine] more obvious, but not so. We have this tripartite [OIE-FAO-WHO] but that's a twisted institutional structure, and it's almost impossible for them to move forwards. So you might say that what we have to deal with is a misconception in an institutional void. The big thing to ask is how did we come to such a situation? One answer is the irresponsible vet profession which should be serving humans as well as animals but are basically serving to prop up business. They turn it upside down. Where does human health, food safety, animal health come in this equation?

Similarly, political and diplomatic pressures associated with the importance of avoiding any geographical stigmatisation brought about by naming have led to surprising gaps in knowledge concerning what went on where and why. Very shortly after the outbreak was detected, both WHO and FAO reportedly sent investigatory teams to La Gloria in Veracruz state, which had been identified by the international media as 'ground zero' of the outbreak and the site of a number of factory pig farms, including a locally unpopular facility owned by US-based Smithfield Foods (GRAIN 2010). Between 5 March and 10 April, 616 cases of influenza like illness (ILI) had been reported from this small village, representing about 30 per cent of the population (CDC 2009). Nevertheless, no official independent reports are yet available either implicating or clearing the pigs, or the farming practices, in the area, or explaining why so much media attention came

¹¹ Interview, Davos, 21 February 2012a

to focus on it. One US-based flu researcher interviewed said:

When I went to Mexico in 2010 I wasn't able to get much clarity on how the disease started. I asked around and got stories that it had in fact started in the Imperial Valley of Southern California where a lot of migrants end up. Technically that might be right. Or a person could have travelled from Mexico into California and been diagnosed there. The fact is no one knows.¹²

Given the relatively clear picture the genetics of the virus presents, however, the relevant questions must be why no one knows, and why no one appears to want to know. A preliminary analysis, later confirmed, which was published speedily on 30 April 2009, had pointed to 'at least two swine ancestors to the current H1N1, one of them related to the triple reassortant viruses isolated in North America in 1998' (Trifonov *et al.* 2009). Before 1998, only one influenza subtype had been detected in North American pigs in the previous 60 years. Since August that year, and an outbreak on a North Carolina farm, a succession of rapidly evolving flu viruses have been detected in North America's 100 million pigs (Wuethrich 2003). The rapid rise of intensive farming practices, increased vaccination (which can select for new viral types), and transport of live animals is held responsible (Webster and Hulse 2004; Gilchrist *et al.* 2006; Greger 2009). Recognising these factors, in November 2003, the American Public Health Association called for a moratorium on new intensive Concentrated Animal Feed Operations (APHA 2003), and in 2008, the Pew Commission on Industrial Farm Animal Production (noting that its efforts to gather unbiased information had been affected by the industry's undue influence on academic researchers) went so far as to recommend phasing out, within ten years, all intensive [animal] confinement systems, concluding that 'many practices common to this method of production threaten public health, the environment, animal health and well-being, and rural communities' (Pew Commission 2008: 21). According to the 'NAFTA flu' proponents at least, such domestic concern has done little except to encourage the industry to expand beyond US borders into more lightly regulated regions, that often mix industrial and smallholder agricultural systems, and put poor people in the front line of infection.

¹² Telephone interview, 20 December 2011c

This issue, of course, is not unique to the Americas. An animal health specialist interviewed was keen to expand the geographical scope of concern:

In 2009, the fingers did rightly point at La Gloria. But then there is the question – where did the Asian genes [in the virus] come from? There must have been some contact between east Asia and Mexico. Nowadays China and Mexico are exchanging a lot. I think we can assume that there are Chinese pigs being shipped to Mexico. We also should note that there are some 7.5 million pigs being kept by smallholders in Mexico, out of a total pig population of around 15 million. There's a chance that this might actually have started in a Pacific port. But no one is really looking at this.¹³

Again, a question mark must hang over why no one is looking. An internationally experienced veterinarian pointed to the difficulties of determining any definitive answer:

It's not my area so I am talking out of turn, but that highland area around La Gloria mixes intensive industrial pig farming with lots of backyard pigs. That's one factor in my view. Another was the linkages between Veracruz and Mexico into the USA. I like the idea of the NAFTA flu. But all this is very sensitive politically because it points fingers.¹⁴

Doubtlessly, the issue of where and how this, or any outbreak, starts is highly sensitive and potentially embarrassing, but is it right that such niceties take precedence over protecting the world from flu? Might it not serve the cause of protection better if a country or a region realised that dangerous practices on its territory would lead to international shame? As matters stand, novel flu viruses are increasingly likely to be generated and spread by industrialised agricultural systems, particularly those operating in unindustrialised or industrialising regions.

To sum up, the complexities and contestations associated with the naming of the novel influenza virus in 2009 suggest that at least three major actor networks are involved, each concerned with its own interests, and therefore inclined towards different framings and terminologies. The first is a relatively elite bio-medical network which is determined to define a precise technical term irrespective of its acceptance or comprehension outside the network. An incomprehensible or unpopular term may actually serve the interests of such a network by reinforcing its exclusivity and serving to sustain it, even at the expense of expanding it. The second is a commercially inclined and politically well connected network of pork meat producers and processors, which is most concerned that any nomenclature does not affect its business activities. On the face of it, the appearance of such a group is unexpected, but their concern and influence is significant. Unless

¹³ Interview, Davos, 21 February 2012a

¹⁴ Interview, Davos, 21 February 2012d

they are engaged, novel flu viruses are likely to be generated and spread at an increasing rate. The third actor network might be characterised as 'the general public', which includes the mass media and globally encompasses a very wide range and shifting number of attitudes and concerns. For this group, a range of names of terms are acceptable, as long as none point any fingers of responsibility or blame at them specifically. As noted above, in Mexico, one of the most badly affected countries, an entirely generic name served. In the persistence of 'swine flu' in popular usage, however, it would appear that popular understandings and concerns are holding sway.

Even at first sight then, and considering what should have been the most simple of issues - naming - influenza appears as 'slippery' a disease as Neustadt and Fineberg suggested in 1978. In similar circumstances of uncertainty, the 2009-10 event saw contested claims to knowledge and authority, with expert scientific understandings varying from public understandings, and policy makers struggling with political and commercial forces. In 2009-10, with these contestations amplified by increasingly critical and reflexive publics and intensive media, flu might be argued to present an even more potent mix of science, policy, politics and people than in 1976.

The next section examines the definition of a key term of the event - 'pandemic'. If the naming of the 2009 virus, and the event, sent some awkward gusts through the global corridors of public health, diplomacy and trade, this definition caused a small storm. WHO's announcement on 29 April 2009 to move to phase 5 of the organisation's predetermined 1-6 pandemic alert scale, which signalled officially that a pandemic was underway, led to unprecedented criticism of the organisation. The issue serves to further illustrate the gap between technical and popular framings of the 2009-10 event, and offers the opportunity to investigate in more detail the characteristics and consequences of the framings that drove and defined official narratives and response pathways.

3. What's a pandemic?

The world was waiting for a pandemic... and I think that just because people were waiting for this event to occur, when it did occur, everybody capitalised on it.¹⁵

To pandemic or not?

Following the surge of reports, mentioned above, of an influenza-like-illness (ILI) in Mexico in March and April 2009, and the detection in mid-April of a novel flu virus in samples from two children in California and in samples from Mexico analysed in Canada, on 23 April US authorities confirmed seven human cases - five in California and two in Texas - and nine suspect cases, and a day later announced that samples from cases in Mexico matched the strain detected in samples from the USA.¹⁶ In the early hours of the same day, WHO activated its Strategic Health Operations Centre (SHOC) in Geneva, and began recruitment of an advisory Emergency Committee from a roster of experts. The next day, 25 April, following consultations with the Emergency Committee which had convened by teleconference, the WHO Director-General declared a Public Health Emergency of International Concern (PHEIC). Defined as 'an extraordinary event which is determined to constitute a public health risk to other States through the international spread of disease and to potentially require a coordinated international response' (WHO undated), PHEIC is a key concept in the revised International Health Regulations (IHR) 2005, which came into force in June 2007. Among other provisions they oblige WHO to obtain expert advice on the declaration and discontinuation of a PHEIC. Subsequently, on 27 April, following laboratory confirmation of cases in Canada, Spain and the UK, WHO raised the pandemic alert phase from 3 to 4, and on 29 April, following confirmed cases in Israel and New Zealand, and the death of a baby in Texas, from phase 4 to 5. At that time, 148 cases had been laboratory confirmed in nine countries on three continents (WHO 2009b).

For many of the 194 countries that are signatories to IHR(2005), the shift to phase 5 was more than semantic. The regulations required that those that had pandemic preparedness plans should activate them, and for many wealthier countries the declaration of phase 5 meant that pre-negotiated 'sleeping' contracts with pharmaceutical companies to provide pandemic vaccine and additional supplies of anti-viral drugs came into effect. As discussed in more detail below, as the

¹⁵ Interview, London, 9 February 2012b

¹⁶ The first US cases were detected by chance. The infections in children in southern California were discovered in a trial of an investigational tool developed to detect the H5N1 influenza A virus. The other case was identified from a sample collected as part of an influenza surveillance project (Relman *et al.* 2010: 14).

world's flu vaccine production capacity is limited, and as producing a vaccine against a novel virus typically takes four to six months, many developed nations had made commercial arrangements that automatically came into effect on WHO's declaration of phase 5 in order to assure the fastest possible delivery of supplies. The UK, for example, had such agreements dating from July 2007 with GlaxoSmithKline (GSK) and Baxter for up to 132 million doses of pandemic specific vaccine (National Archives 2009).

Subsequently, as the pandemic developed to be significantly milder and less lethal than anticipated, and with some rich nations left with unused stocks of costly pharmaceutical supplies, critical attention focused on WHO's pandemic alert scale and related declarations. In particular, in January 2010, vocal criticism emerged from the Parliamentary Assembly of the Council of Europe (PACE)¹⁷ claiming that the Emergency Committee advising WHO had been subject to undue commercial influence. In March 2010, the Council of Europe then launched an inquiry into 'the influence of the pharmaceutical companies on the global swine flu campaign', and on 24 June 2010 the Parliamentary Assembly voted overwhelmingly (62 votes for, 1 against and 1 abstention) in favour of a motion criticising WHO and calling for 'more transparency' in the organisation's affairs.

At the 24 June sitting WHO was described as 'an excellent organisation' and 'an effective organisation', but there was also a wide range of criticism, some of it extreme. The Assembly spoke of a 'very closed organisation' and the need to be 'hardest on those it most loved'. Regarding the specific complaints of the PACE report, comments included: 'a global scandal', 'a nasty smell', 'a criminal offence against the taxpayer', and 'governments and citizens deceived' resulting in 'fear and anxiety and billions wasted'. It was suggested that WHO had committed a 'foolish act', made a 'bad decision' and behaved in an 'unscientific and irrational' way. Furthermore it was claimed that '... nearly every one of the people concerned either was or had been in the pay of one or another of the drug companies' and with 'only 10 per cent of the vaccines used' there was 'betrayed trust' that needed to be restored by 'increased transparency'. The pharmaceutical companies were also harshly criticised. They had 'failed in respect of their social responsibilities' and 'put private interests above the general interest' using 'deft marketing' to 'fill their pockets' at 'huge costs' for states. States which had 'signed extensive secret contracts with laboratories' were also criticised: 'democracy means dialogue, the provision of information and transparency' (Council of Europe 2010).

There was more considered comment too. Several speakers contrasted the pandemic response with 'poor people fighting hunger, diarrhoea and disease in poor countries', which were 'not so interesting to the pharmaceutical industry', and noted the persistent toll of chronic, non-infectious diseases worldwide. The

¹⁷ This is composed of 636 representatives drawn from the parliaments of each member state of the Council of Europe and is not to be confused with the European Council or Council of the European Union.

philosophical challenges of 'wanting to know everything before acting meant not acting at all' and 'the increasingly technical nature of issues on which politicians were required to make decisions' were recognised, however, as well as the difficulties this creates when making public health decisions. 'How is it possible to have democratically accountable decisions when it is necessary to rely on expert technical advice in making them?' one member asked, echoing Neustadt and Fineberg's 1978 concerns. Public faith in doctors and medicine generally was also questioned, together with the role of media and the internet as 'proper sources of information'. Concluding comments stressed that decisions need to be made about health for 'the best possible scientific reasons' not 'contaminated by the need for profit'; and that there was a 'need to re-examine the relationship between experts and the rest of the body politic in complex democratic societies' along with a 'change towards good governance and a clear policy on lobbying'. Without change, it was concluded, 'the loss of faith in these institutions may be disastrous if - or when - a real pandemic threatens the lives of people in Europe and all over the world'.

In parallel with the PACE investigations, a set of broadly similar criticisms were published in the well-regarded British Medical Journal (Cohen and Carter 2009 *op cit*). These noted that the identities of all but one of the members of the WHO Emergency Committee were unknown outside WHO, and suggested that key pandemic preparedness advice covering vaccine use and the stockpiling of anti-viral drugs had been influenced by advisers with undeclared links with the pharmaceutical industry. The journal also detected dark forces behind WHO's May 2009 removal of a severity measure from its long standing pandemic definition, and complained that the selection process for the review panel announced by WHO to consider IHR(2005) and the H1N1 pandemic response in early January 2010 was 'incestuous' (p. 1279).

The WHO response was prompt and unequivocal. Keiji Fukuda, Special Adviser to the WHO's Director-General on Pandemic Influenza, insisted that the agency hadn't overplayed the dangers, but used a principle of precaution that meant it 'prepared for the worst and hoped for the best' (WHO 2010e). At PACE's first public hearing on 26 January 2010, in which Wolfgang Wodarg suggested that around US\$18 billion had been wasted in the pandemic response worldwide, Fukuda said: 'Let me state clearly for the record: the influenza pandemic policies and responses recommended and taken by WHO were not improperly influenced by the pharmaceutical industry' (WHO 2010f: 3). Following the BMJ publication, WHO Director-General Margaret Chan wrote to the editors on 8 June: 'WHO needs to establish, and enforce, stricter rules of engagement with industry, and we are doing so. However, let me be perfectly clear on one point. At no time, not for one second, did commercial interests enter my decision making' (WHO 2010g).

Similarly, the WHO review report, a detailed 180-page document published on 5 May 2011, found no evidence of malfeasance on the part of WHO, although

it did, amongst what it characterised as a generally robust performance, identify some systemic difficulties and shortcomings (WHO 2011b). Declan Butler (2010) writing in *Nature* also quickly and prominently railed against the PACE/BMJ analysis commenting that 'Nothing could be further from the truth', and Ananyo Bhattacharya, chief online editor of *Nature*, stated via Twitter that the BMJ article has been 'discredited' and was 'crank' journalism.¹⁸

Aside from this unprecedented and widely reported criticism, more nuanced comment emerged in the academic journals. Bonneux and Van Damme (2010) argue that both H5N1 avian flu (2005-6) and H1N1 swine flu epidemics were 'iatrogenic pandemics of panic', which caused little human suffering, that the global plans to control them were largely a waste of money, and that WHO failed to give appropriate guidance in both events. Enquiring whether this was the consequence of rational risk management in conditions of uncertainty, or of close working relationships between disease experts and the drugs industry, they suggest that in conditions where resources are not infinite, modern disease experts are unsuitable to make allocation decisions as they 'know a lot about the disease in question, but do not necessarily know much about general public health, health economics, health policy, or public policy', and that as specialists, they are 'often biased and are increasingly part of industrial networks' sharing interests with industry to 'try to expand demand for research and drugs for their disease of interest'.

Doshi (2011) details the WHO's 4 May 2009 revision of the 'description–definition' of a pandemic to exclude the phrase an 'enormous numbers of deaths and illness' so that a revised version read: 'An influenza pandemic may occur when a new influenza virus appears against which the human population has no immunity' which allowed WHO to move to phase 5 in the absence of 'enormous numbers'. He suggests that 'virus-centric thinking' is at the root of the problem which dichotomises influenza into 'pandemic' and 'interpandemic' or 'seasonal' influenza categories, on the basis of genetic mutations of the virus alone. He also argues that this approach ignores the fact that the severity and impact of epidemics, whether caused by influenza viruses or other pathogens, occur along a spectrum and not in catastrophic versus non-catastrophic proportions, and that responses need to be calibrated to the nature of the threat rather than driven by rigid categories (Doshi 2009).

Meirion Evans (2010), a member of the UK Scientific Pandemic Influenza Advisory Committee and the UK Scientific Advisory Group on Emergencies, suggests that the issue boils down to a problem of confidence in public policy-makers: 'When it comes to policies on pandemic flu, there is an inherent conflict between the pharmaceutical industry, WHO and the global health system. Almost inevitably,

¹⁸ The BMJ's editor's response and other comments are available at: http://www.bmj.com/content/340/bmj.c2947.full/reply#bmj_el_238169 [accessed 18 August 2011].

they all draw on the same pool of experts. The issue is therefore not so much about avoiding conflicts of interest but about properly dealing with them' (p.296). She concludes: 'It is vital that such influential decisions are made in the clear light of day and that the decision-making bodies involved can demonstrate that they have effective mechanisms to deal with conflicts of interest. In this regard, the WHO arrangements can be seen to be woefully inadequate' (p.297).

Again, in all of this, Neustadt and Fineberg's conclusions resonate. Little appears to have changed between 1976 and 2009. Scientific and bio-medical expertise remains challenged by the uncertainty pandemic flu presents. Bio-medical networks, determined to define issues in narrow, scientific terms find themselves at odds with the complexity and diversity of real world experiences, and with scientific knowledge claims in doubt, policy making easily finds itself subject to dispute and the influence of external, non-scientific interests. In such circumstances, science can find itself compromised, selecting or adjusting its facts to co-evolve with policy in a process remote from oversight and democratic accountability (Jasanoff 1990; Wynne 1992; Jasanoff 2004; Van Zwanenberg and Millstone 2005). The paper continues to explore the implications of a reductive scientific framing in the circumstances of uncertainty pandemic influenza presents below. First it identifies some other issues related to technical and popular understandings, and media coverage, that further challenged the credibility and authority of WHO's 2009 definition and declaration.

Real world matters

As a technical organisation, WHO was challenged from the outset of the event by a reductive, scientific epistemology. No bio-medical definitions of a pandemic make any reference to the severity or mortality. Merriam-Webster's medical dictionary, for example, defines a pandemic as a disease 'occurring over a wide geographic area and affecting an exceptionally high proportion of the population', and an epidemic as 'affecting or tending to affect an atypically large number of individuals within a population, community, or region at the same time'. Thanks largely to the scriptwriters and producers of Hollywood movies, popular opinion as to what constitutes a pandemic - mass mortalities and bodies piled cinematically in the streets - is often at variance from this. Whilst WHO might have been technically correct in declaring a pandemic, it is therefore unsurprising that global publics were first alarmed and later confused.

A closer examination WHO's pandemic alert scale (see Annex 1) also throws up some awkward inconsistencies. With phase 5 defined as 'The same identified virus has caused sustained community level outbreaks in two or more countries in one WHO region', a pandemic could be declared on the basis of an outbreak on any national border (Egypt and Libya, say, or even, at a stretch, England and Scotland), and for phase 6 to be declared, defined as 'In addition to the criteria defined in Phase 5, the same virus has caused sustained community level outbreaks in at least one other country in another WHO region', the countries need

only sit on each side of WHO's somewhat arbitrary regional borders (Algeria and Libya, say, or Thailand and Malaysia). Such rigid definitions are also challenged by the fact that following WHO's 10 August 2010 declaration of the end of the pandemic - or, more accurately, the arrival of a 'Post-pandemic period' - influenza caused more deaths (474 versus 361), more critical care admissions (2,200 versus 1,700), and more hospital admissions (8,797 versus 7,879) in England in the following year than during the 'official' pandemic itself (Mytton *et al.* 2012), and a similar pattern has been reported from Taiwan (Chuang *et al.* 2012). Again inflexible, technical definitions and determinations can be seen to sit badly with popular understandings, concerns and experiences.

Similar inflexibilities led to similar confusions following early reports from Mexico which suggested that the novel virus was highly lethal. One respondent explained:

Around 50 per cent of those infected with H1N1 were dying. Fifty per cent mortality! That's about the same as H5N1, but this was contagious. Those reports from Mexico were not false, but what we did not realise was that most people with this virus were in fact only so mildly ill they did not realise they had flu, and it was only those who went to hospital with a serious infection that were counted.¹⁹

Behind all of this, of course, is the compounded uncertainty Neustadt and Fineberg so clearly identified in 1978. In addition to uncertainties associated with where and when a novel virus might emerge, uncertainties abound in the effects the disease might have on human populations, and how those populations will react. Another respondent said:

So as to the question as to whether it was called incorrectly, and there are people saying that WHO could have assessed more early that it was not as severe as it was thought at the beginning, I come back to the point that we had not been in this situation before, where we had the amount of planning, the amount of surveillance, and therefore just because the initial impressions were that the mortality rate was high, we did not know what was going to happen.²⁰

There were also vivid media reports from Mexico City in particular, which moved decisively to address the outbreak. One comment, for example, sent to BBC News in late April 2009 read as follows:

The truth is that it is very strange, what we are living through here. The streets are empty, we are all staying in our houses. People are only going out to the hospitals, drugstores and to buy food. The great majority have

²⁰ Interview, London, 20 December 2011a

²¹ Telephone interview, 15 December 2011

their mouths covered. Concerts, festivals, masses have all been cancelled, the football matches have all been played behind closed doors. On the television and radio, every commercial break contains information on the symptoms, saying that if you have them to go to the doctor at once.²¹

In these circumstances, with deaths and a deserted city making news worldwide, it would have been impossible for any agency charged with protecting global health to adopt a 'wait and see' attitude. An 'outbreak' narrative was in full flight: this was an emergency that required an exceptional, rapid, and robust response from the global apparatus, which was primed and ready largely thanks to IHR(2005), and national and international pandemic preparedness plans which had been under development since 1999. As one respondent put it:

The world was waiting for a pandemic... and I think that just because people were waiting for this event to occur, when it did occur, everybody capitalised on it. The other reason that there was a big stir in 2009 is because communications have changed [and] because of SARS, H5N1 [avian influenza], people thought we were going to have another bad one. We may get that one day, but this was not it. But things have changed. Pandemics in the past never raised this level of emotion.²²

According to another respondent, there were other personal and institutional factors at play in WHO headquarters:

This time round perhaps not exactly by accident Margaret Chan was running this and her background had been in flu in Hong Kong. Also here there was a pressure point that acted on a lot of the self interests of WHO member states to get involved with, and to see, some WHO action. And then there was SARS where WHO had been significantly involved so there were some models and investments that had already been made in the shape of the response. This was the legacy of Chan's background. The financial and political background which made everything fit together.²³

In the supposedly independent, purified domain of science, then, a range of non-scientific forces are at play, including history, fear and even personality. In its own reductive terms, science can therefore be presented as failing, influenced by non-scientific forces. This is one consequence of the uncertainty and complexity of flu. As will be discussed next, mixing science with people and politics, particularly in conditions of uncertainty and ignorance, tends to produce inflexible and reductive solutions remote from processes of democratic engagement. At the centre of an

²¹ Source: BBC News. Available at http://news.bbc.co.uk/2/hi/talking_point/8018428.stm [accessed 14 August 2011].

²² Interview, London, 9 February 2012b

²³ Interview, London, 19 December 2011b

actor network defined and driven by such a challenged epistemology, WHO is in a weak position to provoke or manage any change.

The allure of the model

In the context of international relations, Haas (1992: 3) identifies what he calls 'epistemic communities' - 'communities of shared knowledge' - which can display undue and biased influences. More specifically, he suggests that 'network[s] of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area' may collude, even unwittingly, to devise solutions that support a technical, scientific viewpoint, and exclude others, without scrutiny or political oversight (1989: 377).

Such a community, or actor network in this paper's terms, in the shape of WHO's Emergency Committee, appears highly influential in guiding global decision-making during the 2009-10 pandemic. At the time, the membership of the Committee was not public, with WHO claiming that not naming its members was the best way of protecting them from undue influence. Once the pandemic was declared over, on 10 August 2010, WHO published the list of members of, and advisors to, the Committee according to its protocol. This group (see Annex 2) is more varied, and less commercially-inclined, than many of the critics suggest, but one respondent, who was close to the considerations of the Committee, pointed to one of the characteristics of such a technically and culturally homogenous network:

I think we learnt a number of lessons from it [the pandemic]. One of them related to the limitations of surveillance. [Another was] when we were faced with a question which we had probably not considered enough up to that point, a sort of group-think went on, that meant almost by definition, we did not prepare for a mild pandemic.²⁴

The same respondent pointed to two potentially dangerous consequence of this position, which chimes with concerns raised over epistemic communities in other domains. First:

... like in many areas of scientific advice, policy makers make judgements about the people they are taking advice from as much as the work itself, because it is hard for them to second guess the subject matter. So the judgement is, is this person sensible? Do they have an appreciation of the difficulty of making policy and the constraints on policy making, of logistics?

²⁴ Interview, London, 13 February 2012

And second:

One issue that is always a challenge in doing research at a policy interface is the extent to which you are willing in public to... publicly embarrass the policy community. [Some people] expend less energy on the politics sometimes, and so have less influence.

Another more critical outsider identified another feature, and danger, of such an epistemologically determined actor network:

So you've got a very tight knit group of influenza experts who all go to the same conferences and are all funded by the same manufacturers, and you're alienated if you ask any awkward questions. The Cochrane Group,²⁵ who have questioned the evidence base, have been accused of threatening people's lives. They have been outcast from the influenza community.²⁶

Even further removed from the 'flu community', another respondent puts the matter in stark terms:

In fact, the truth of the matter is that the so-called experts, in their sectors, were subject to market forces, if I can put it that way. Market forces concerning their organisation's funding. Market forces concerning their professions and their standing, their well-being, their centrality to the international debate. The fact is that it was a technical response that was blind to the bigger, wider issues. [...] You could say that it was driven largely by organisational self-interest.²⁷

This presents a peculiar picture of science in action, but one that appears inevitable given the political economy of knowledge in conditions of uncertainty. Again little appears to have changed between 1976 and 2009. With influenza presenting science with confounding uncertainty, cultural factors emerge to challenge the supposedly apolitical, impartial and independent authority of science. One change between 1976 and the 2009-10 event, however, which many respondents pointed to, was the increased influence of mathematical computer modelling techniques, both for pandemic risk assessment and for mitigation planning. These respondents included social scientists, journalists, public health specialists and the modellers themselves. One social scientist commented:

²⁵ The Cochrane Collaboration is a respected international network of researchers who appraise medical evidence (<http://www.cochrane.org>).

²⁶ Interview, London, 19 December 2011a

²⁷ Telephone interview, 1 February 2012

What I think they [the politicians] are doing is panicking in the face of uncertainty, and grasping onto the science because it appears to be certain. And some scientists are happy to do that, particularly the modellers, because it very much enriches them in all sorts of career ways. [...] One of the things I am quite concerned about is the influence of a very, very small epistemic community, of a rather unusual kind, that speaks a language that is very opaque to the majority of those it advises, including many doctors, but above all, many politicians. And because it can present its results in such an extremely crisp form, using all kinds of simulation techniques and presentational techniques, it is very hard for people to go beyond the symbolic representation which comes out of those modelling exercises, to ask any questions, let alone any difficult ones. The language, literally the mathematical language, which is used to construct those models, I suspect is understood by no more than about 30 people in the whole world. [...] I think one of the most helpful things that could happen in relation to surveillance of infectious diseases is to have first a much more general debate among a knowledgeable community as to what these models actually mean, and secondly to try and educate the general public a little bit about what these models mean.²⁸

Another respondent, starting from the familiar issue of uncertainty, suggested:

We can't predict the genetics of a new virus. Nobody can predict in advance the transmissibility or the potential health impact of a new flu virus until it is with us. I think there was a legitimate debate that was not picked up early enough around how H1N1 was not going to have the impact expected. Was that the fault of scientists? To some degree. Maybe there was some exaggerated modelling... I must say I am very sceptical about the workings of some of the models in other diseases as well. HIV for example, where there were also huge upwards curves that turned out to be misleading.²⁹

A mathematical modeller was explicit, and slightly exasperated, commenting:

Policy makers need an introduction on what models can and cannot do, especially with infectious disease. These models are not like engineering models for example, like those for a rocket. We often don't have counterfactuals for epidemiological modelling. I sometimes think modelling for flu is almost a waste of time.³⁰

²⁸ Telephone interview, 20 December 2011b

²⁹ Interview, London, 19 December 2011b

³⁰ Interview, Oxford, 7 February 2012

Another public health specialist said:

I think the modellers are very important in placing scenarios, in saying this is what will happen if this and this and this occur. The problem then is that people take those estimates and just throw them about, they don't put any caveats on them. [...] The assumption is that this will transmit at such and such a rate, or that it will have such and such a mortality, that gets lost when the headline figures go out. [...] It's just the headlines that get out, none of the detail on the assumptions, which may be questionable or open to challenge. It needs to be stressed that this is what happens if these conditions are met, and it's the same with vaccine and anti-viral drugs.³¹

These concerns are succinctly addressed in epistemological terms by Erika Mansnerus (2009; 2010), who, considering the 2009-10 event, stresses the key role mathematical representations and modelling techniques played in knowledge claims implicit in finding 'robust and reliable' evidence for decision making. Arguing that modelling exercises only begin when evidence is 'silent', i.e. when facts cannot be fully supported by evidence, she shows how mathematical representations are dependent on uncertain epidemiological knowledge such as estimates derived from past data concerning the microbiological characteristics of the virus, the effectiveness and safety of pharmaceutical interventions, and estimates for parameters such as transmissibility. In Mansnerus's terms, facts have their own 'life histories', which only survive within a specific epistemological network.

The authority of modelling then, appears dubious. Is it unbiased and 'pure', or does it simply create and support narratives emanating from the epistemological frame of science, and obscure or close down alternative understandings and response pathways? The challenges this troubling framing present are discussed next in the context of the allegations of impropriety that were made against WHO.

WHO's responsible?

Shifting with humankind's fears, epidemics, and their more frightening siblings, pandemics, both create opportunities and allow people to blame unpopular groups, especially if the causes of the event are unclear (Alcabes 2009). With the animals - pigs and birds - that are both the reservoir and the crucible for all flu viruses so efficiently removed from any narratives of blame (as discussed in the previous section), it was inevitable that responsibility for the 2009-10 event would be directed elsewhere, and given WHO's role in defining and declaring the pandemic, it is not surprising that blame for the event landed at the organisation's door. In much of the world, corruption and collusion are the norm rather than the exception, and recent events have created clouds of suspicion around many

³¹ Interview, London, 9 February 2012b

previously respected institutions. Nor is it surprising that this blaming was linked with the construction of some opportunity, in the shape of financial benefit for pharmaceutical companies. With a normative mandate set by its constitution as the 'attainment by all peoples of the highest possible level of health' (WHO 2006: 1), WHO might like to think that it is immune to such criticism, but nowadays no institution automatically escapes scrutiny.

Central to the allegations, however, are the analyses and prescriptions of an elite, tight-knit and self-sustaining community of expertise, which draws on, and is defined by an inflexible and reductive epistemology. Before the emergence of H5N1 in Hong Kong in 1997, influenza had received little attention and research funding, and the cohort of 'experts' was consequently small. Furthermore, enmeshed in this actor network, WHO is in a weak position to challenge it. A respondent explained:

What people forget about WHO is that it is not a technical organisation, fundamentally. It has some people who are technically competent but it does not do research, unlike CDC [the US Centers for Disease Control and Prevention] and HPA [the UK's Health Protection Agency]. It does not even really run field operations in a concrete way. They collate data but they do not really have any serious analytical capacity internally. So they rely on networks of experts to evaluate things and contractors and the like. So it can be challenging to find the right people to speak to, what might be called 'the intelligent consumer'.³²

As the organisation responsible for convening this epistemological community, however, and charged with communicating its analyses and prescriptions for wider, global consumption, WHO found itself awkwardly placed, and many national governments, at least to a degree, took the opportunity to shift the responsibility for key decisions away from themselves and onto WHO. In this, politically convenient expectations were being placed upon WHO. One respondent suggested a tiny semantic shift that might help avoid future misunderstandings:

Don't forget that the constituency of the WHO is the Health Ministers in various countries. These ministries have various forces working on them, often the medical profession predominantly, say, as much as the public. Does this serve doctors best, or does it serve the public best? Might it be better to talk of the World Medical Organisation rather than the World Health Organisation?³³

This section has examined the furore that resulted from WHO's pandemic declaration and found that it further illuminates the gap between technical and

³² Interview, London, 13 February 2012

³³ Interview, Davos, 21 February 2012e

popular framings of the 2009-10 pandemic. Against a background of intense scepticism in the integrity of public institutions generally, national and international planning that was primed for such an event, and an exuberant mass media, the expertise that WHO drew on, and had no reason, or means, to temper or question, formed an elite and exclusive actor network prone to group-think and uncritical of its own approaches and attitudes. In order to sustain itself and its internal coherence, this group was obliged to work with, and within, inflexible technical framings, exemplified by mathematical modelling, which carried with them their own biases, and which stood in stark contrast with popular framings that could shift and change according to events. This group was therefore unable to allow any adjustment of technical narratives so as to correspond better with public understandings and concerns, and its existence and working methods offer one explanation for the charges of collusion made against WHO. At the heart of matters was not a nefarious commercial collusion, but an inevitable, but no less dangerous, epistemic collusion.

The next section considers what happens when the purified narratives of a technically-orientated actor network directing the global influenza response coincide with similarly technically-orientated narratives emanating from commercial networks producing vaccine and anti-viral drugs.

4. Why pharmaceuticals?

But people were crying out for vaccine... Can governments really risk saying we haven't thought about vaccine, providing it at any time?³⁴

Vaccine and variety

Vaccine and anti-viral drugs were central to WHO's and many governments' plans during the 2009-10 pandemic for preventing influenza deaths and limiting the speed of spread of the virus. This section first examines vaccination, and then considers anti-viral drugs. In each case, a reductive scientific framing is found to drive and define narrow response pathways, which are incongruent with the varied requirements of individuals, and which suppress appreciation of the uncertainties inherent in flu, inhibiting the development of alternative responses.

In high-income countries, vaccination of the elderly and other 'at risk' groups against seasonal flu is a staple of public health policy. In a normal year, for example, some 100 million US citizens are vaccinated. By administering a denatured virus, or one of very low virulence, an immune response can be provoked in an individual which prevents further infection. This mechanism, which has been used since the eighteenth century, has contributed substantially to improvements in human health over the past century, and licensed vaccines are now available to prevent human infections caused by about 25 pathogens (Smith *et al.* 2011).

Compared to vaccines for measles, for example, or polio, influenza vaccines, the first of which was introduced in 1945, are unusual in that they need constant reformulation to track genetic changes in the virus. Activities associated with influenza vaccine production have been described as the 'cornerstone' of WHO work on influenza (Dehner 2010: 481), which established the World Influenza Centre (WIC) at Mill Hill in north London in 1948, shortly after the organisation was formed (Kaplan 1980). Central to the WIC's activities has been the creation of a collaborative international network of over 120 national centres in more than 90 countries which supply virus samples to five WHO collaborating centres in Atlanta, Beijing, Tokyo, Melbourne and London for antigenic and genetic analysis before WHO prepares two annual influenza strains recommendations (one for each of the planet's hemispheres), which are passed to manufacturers for production. WHO is therefore entwined with a large commercial enterprise producing influenza vaccines. As of June 2009, the total global annual capacity for trivalent (containing three virus strains) seasonal influenza vaccine production was 876 million doses, and the target for 2009-10 Northern hemisphere production was 493 million doses (ECDC 2009).

³⁴ Telephone interview, 1 February 2012

Vaccination as a response to pandemic influenza, however, is challenged by a number of factors. First, whilst the 50-year-old technology and egg-based production system may be adequate for producing limited amounts of seasonal flu vaccine, in a pandemic it is insufficient and slow to provide even for the high-income countries which, as discussed in the next section, received the bulk of production fastest. The first doses of pandemic H1N1 vaccine became available in late September 2009, about five months after the new flu virus was detected, and in the UK, for example, vaccination began among priority groups on 21 October 2009, which was some three months after the pandemic's first peak, and a month after the second (Hine 2010: inside front cover). Early projections, and hopes, that vaccine would be available in time to counter even a second wave of infections were unrealistic.

Second, across the developed regions of the world where it was available, public demand for pandemic vaccine in 2009 was unpredictable. Whilst governments were subsequently subjected to criticism for over ordering vaccine, considerable pressure was applied on them at times during the pandemic to ensure a ready supply. In the USA, for example, on 29 October 2009, one New York Times headline read: 'Shortage of Vaccine Poses Political Test for Obama', and the previous day, staff in Los Angeles County's free H1N1 vaccination clinics had reportedly been 'overwhelmed' and vaccinated many people who were not in priority groups (Stolberg 2009).

On many occasions and in many places, however, many people were unwilling to be vaccinated when offered the opportunity. In Western Australia, for example, uptake was less than 10 per cent among pregnant women (who were prioritised), and only 15 per cent among other adults, with low uptake attributed to safety concerns about the vaccine and perceptions that the pandemic virus was mild (Mak *et al.* 2010; White *et al.* 2010). In Turkey, a study of university students indicated that 93 per cent of those surveyed were not prepared be vaccinated, due to concerns over safety and side effects, although 25 per cent perceived their personal risk of influenza as 'high' and 40 per cent as 'moderate' (Akan *et al.* 2010). In France, where a mass vaccination campaign was launched in October 2009, with vaccination offered free of charge to the entire population according to a pre-defined order of priority, overall uptake was around 8 per cent, and uptake in pregnant women 23 per cent (Bone *et al.* 2010). In the UK, roughly 80 per cent of people chose not to be vaccinated, many because they doubted they were at serious risk (Lancet editors 2010).

Even many medical staff and healthcare workers, who might be expected to show greater willingness, appeared unenthusiastic to be vaccinated during the pandemic. A study of over 500 doctors and nurses in Turkey found 18 per cent willing, and 44 per cent unwilling, with only 11 per cent stating that they would be prepared to vaccinate their children (Arda *et al.* 2011). In Spain, a study at a university teaching hospital found H1N1 vaccination rates of around 15 per cent, and in Greece a nationwide survey covering 152 of 380 healthcare facilities,

suggested that only 22 per cent of staff intended to get vaccinated (Maltezou *et al.* 2010; Del Campo *et al.* 2011). Another study comparing responses among nurses and healthcare workers in Hong Kong, Singapore, and the United Kingdom, found uptake rates for pandemic vaccine of 14 per cent, 36 per cent and 41 per cent respectively, with those more senior in the medical hierarchy more willing (Chor *et al.* 2011).

Time and again, across a wide range of studies, concerns emerge that unsafe pharmaceuticals may be rushed to market during a pandemic, which, coupled with a low perception of the risk of serious illness, led to low uptake (Henrich and Holmes 2009). The longer the public had to wait for the vaccine, and the more they learnt about the pandemic, the less likely they were to get vaccinated (Gidengil *et al.* 2012). As fears of a deadly pandemic, and personal concerns of illness declined, public anxieties about vaccines and vaccination came to the fore. In this, an increasingly common pattern of ambivalence, and occasionally open resistance, to mass vaccination can be detected, which found ready expression via the internet. Whilst from an epidemiological, population-level perspective the case for vaccination might seem compelling - be it against flu, measles or even polio - at the individual level, the decision to be vaccinated, or not, hinges on social processes, personal experiences, and political concerns (Leach and Fairhead 2007). These complexities became evident during the 2009-10 pandemic event. One respondent observed:

In the US and other developed countries one lesson that has been learned is that you cannot vaccinate purely on epidemiological grounds. You have to do it in consultation with the public. CDC recognises this now: you can't vaccinate on purely technological epidemiology. If there is vaccine available, its uptake depends almost entirely on what the community wants. And this will vary from community to community. Not just geographically: you can talk of a community of pregnant women for example.³⁵

Another respondent, a public health official, was explicit:

I think we should learn from the 2009-10 pandemic by recognising that a policy founded on mass vaccination was never going to work given the current vaccine technology. Even if you look at Canada, which is well prepared, it had contracts in place with a domestic manufacturer, it had put money into developing infrastructure, even Canada was hard pressed to show that the vaccine got distributed into the arms of people at the right time.³⁶

³⁵ Interview, Davos, 21 February 2012c

³⁶ Telephone interview, 15 December 2011

Recognising that death or severe illness in someone known to an individual has substantially more impact than mortality statistics relayed through the media, the same respondent said:

Public expectations demand that vaccine is available for those that want it, but we don't necessarily want it, and those requirements can vary from day to day. A high profile death occurs for example, and then those expectations can flip. One day an individual was not going to be vaccinated. The next day they are. How does public health policy cope with that?

Another respondent put it succinctly: 'Population level decisions have a very different set of criteria from individual decisions. What is correct at a population level is not necessarily correct for an individual patient'.³⁷

Increasingly, then, people require flexible, individualised bio-medical schedules, which the rigidities of provision of vaccine in a public health emergency cannot meet. Whilst the scientific, evidence-based epistemology that underpins population level decisions cannot change from day-to-day, the choices and decisions of individuals are far more mutable. Again a narrow epistemological framing determined by, and driving, a tight-knit scientific community can be seen to be incongruent with the plural and varied requirements of individuals. This challenge, however, found little expression among health policy makers, global or national. The UK's Hine report, for example, presented the provision of vaccine as a triumph:

The 2009 H1N1 pandemic was the first where the UK had a specific vaccine available for use while the virus was still causing disease in the nation. This in itself has been a significant achievement for manufacturers, regulators and policy-makers, and reflects in no small part the exceptional level of preparedness the UK has attained. (p.13)

Among these intertwined groups a narrative prevails that these issues will disappear, or significantly diminish, given improved vaccine technology, and work is underway on new types of vaccines that can be produced faster in greater quantities. According to one analyst interviewed, the 2009-10 pandemic has created a resurgence of interest in flu vaccines in the pharmaceutical industry. Nevertheless, as ever with flu, and particularly pandemic flu, matters are not simple. The same analyst explains:

The fundamental challenge relates to clear long term demand. The drug companies will invest in production if there is a clear signal that they would be paid for it. But the reality is that most developing countries, even most developed countries outside certain risk groups, don't make

³⁷ Interview, London, 9 February 2012a

that commitment. For years, WHO and others have said we should be giving seasonal flu vaccine to all working adults, the cost/benefit is quite clear, but it doesn't happen. And the more you produce, the lower the unit cost of course. [...] Flu is this sort of generic problem where there is actually very little incentive. Most of the big vaccine producers are not actually that interested in flu, because it is uncertain and because it is low margin. Look at say, an Alzheimer's vaccine, or one for rotavirus, all of these newer vaccine targets are potentially more profitable and there is big investment in them. [...] Flu - it's been around for generations, the vaccine kind of works, the big companies can't get out of it morally, but it's not really a money spinner. They see a demand for seasonal use but are not really prepared to invest there. They just keep going with egg-based production because it doesn't demand much investment. There's no real active investment.³⁸

At an influenza-themed Royal Society meeting in London in March 2012, a pharmaceutical industrialist concurred with this analysis.³⁹ Suggesting that around 1.1 billion doses of monovalent H1N1 vaccine had been produced globally by all manufacturers in response to the 2009-10 event,⁴⁰ and that the world's current capacity of around 2.2 billion doses in a 12-month period, which is anticipated to rise to 5.2 billion doses in 2015, would be difficult to sustain without increased demand for seasonal vaccine, he said: 'Industry capacity is greatly in excess of forecasted demand [...] and industry cannot live with oversupply for very long'.⁴¹

In order for sufficient pandemic vaccine to be produced, then, demand for seasonal vaccine needs to increase, but as has been shown, demand is lacking, and public ambivalence and concern regarding vaccination is increasing. This sets a further fundamental challenge to vaccine as a solution to pandemic influenza, which is potentially exacerbated by a rising number of questions concerning the efficacy of influenza vaccine. These are discussed next.

³⁸ Interview, London, 19 February 2011b

³⁹ London, 4 March 2012

⁴⁰ This might be set against the 6 September 2010 statement from WHO's immunization and vaccines department indicating that about 350 million doses of H1N1 vaccine had been administered worldwide (CIDRAP 2010).

⁴¹ It was not made clear how many doses would be required for protective immunity.

Does the vaccine work?

With post-pandemic discussions focusing most significantly on the availability of vaccine, few technically-orientated interviewees questioned the efficacy of vaccine to prevent illness once it has been administered. Yet a number of recent studies on seasonal influenza suggest that this is less certain than many expect. A recent meta-analysis of 44 years worth of vaccine efficacy studies suggests that trivalent vaccine offers only 'moderate' protection for elderly people in particular (Osterholm *et al.* 2012). Applying criteria to filter out potential bias and confounding factors, this analysis examined more than 5,000 studies and found that only 31 provided reliable evidence on the effectiveness of flu vaccines, and that the pooled results from these suggested that standard vaccines had an efficacy of 59 per cent in adults. No Randomised Control Trials (RCTs) were found that demonstrated efficacy in adults aged 65 and older, or in children aged 2 to 17. 'Evidence for consistent high-level protection is elusive for the present generation of vaccines,' the authors conclude, 'especially in individuals at risk of medical complications or those aged 65 years or older' (p.42). Similarly in Spain, a separate study suggests that an early estimate of vaccine effectiveness for the autumn 2011 seasonal vaccine formulation was 55 per cent (Jimenez-Jorge *et al.* 2012).

An argument can be made that any benefit is valuable, particularly for healthcare and other essential personnel, but in the heat of post-pandemic allegations and recriminations, few have examined this basic issue. An exception is Brownlee and Lenzer (2009) who present a startling catalogue of concerns regarding the efficacy of seasonal flu vaccination. In 1968 and 1997, for example, when vaccine 'mismatches' occurred (its formulation did not protect against the viruses in circulation) and, in effect, nobody was vaccinated, death rates from all causes, including flu and related illnesses such as pneumonia, did not rise. Nor did mortality rise in 2004 when vaccine production fell behind schedule causing a 40 per cent drop in immunisation rates; and death rates among the elderly during flu seasons in the USA and Canada have actually increased rather than decreased over the years despite the fact that in 1989 only 15 per cent of people over 65 were vaccinated compared to more than 65 per cent today (Eurich *et al.* 2008).

An increasing number of questions, doubts and uncertainties can then be seen to be hanging over influenza vaccine, which are exacerbated in pandemic conditions by concerns among individuals regarding side effects relating to rushed development processes. As has been shown, in 2009 the vaccine arrived too late to have any significant effect, and when it became available, few people wanted it. These drawbacks differ little from those identified by Neustadt and Fineberg regarding the 1976 event when the US government made unprecedented plans to vaccinate every citizen. Whilst presentable as a qualified success in terms of numbers reached - more than 40 million people were vaccinated - the 1976 programme was marked by controversy, delay, administrative troubles, legal complications, and concerns over unforeseen side effects, which combined

to challenge the credibility of public health authorities. The report notes: 'The effectiveness of flu vaccines in the general population remains uncertain' and 'No [vaccination] strategy against the virus, no matter how successful, copes with the whole "influenza" disease problem' (p.93).

Then, as now, uncertainties related to the virus and the illness are compounded both by uncertainties relating to the efficacy of vaccine, and uncertainties relating to individuals' willingness to be vaccinated. Then, as now, a reductive, scientifically defined response can be seen losing authority and credibility. As will be discussed next, a darker and more damaging haze of controversy swirls around the use of anti-viral drugs, which threatens to undermine scientific authority and credibility further.

Inhibiting the virus

Anti-viral drugs, or neuraminidase inhibitors, represent more recent bio-medical technology than vaccines. The best known are GlaxoSmithKline's 'Relenza'TM and Hoffman-La Roche's 'Tamiflu'TM. The active ingredient of Relenza, zanamivir, was identified in 1989 by researchers at Melbourne's Monash University, funded by the Australian biotechnology company Biota. The technology was licensed to what was then Glaxo in 1990 and submitted for approval to the US Federal Drug Administration (FDA) in 1999. Tamiflu, with the active ingredient oseltamivir, was developed by the US-based company Gilead Sciences, and patented and licensed to Roche in 1996. Theoretically, both drugs block the action of the neuraminidase protein on the outside of influenza flu viruses, preventing them from spreading through the body and reducing the severity of illness. Tamiflu has the significant advantage of being a pill, compared with Relenza, which is an inhalable powder, and in the financial year 2010/11 Tamiflu took around 75 per cent of market share (Open Briefing 2011).

When first marketed anti-viral drugs were far from an instant success, clinically or commercially. In 2004, Glaxo sold just £4m (US\$7.4m) worth of Relenza, with the UK's National Institute for Clinical Excellence (NICE) determining that the drug did not offer sufficient value for money to justify reimbursement by the National Health Service. Similarly in 2004, Tamiflu was all but written off because, by pharmaceutical company standards, it was generating so little income. In 2005 and 2006 however, fears of an influenza pandemic caused by H5N1 avian influenza triggered a massive demand as governments rushed to stockpile supplies. In February 2005, Canada, which had been significantly affected by SARS in 2003, became one of the first countries to announce the purchase of a stockpile of Tamiflu, designed to treat nearly 1 million people (at US\$12-15 per course of treatment), and in 2005 Roche reported selling SFr1.6bn (US\$1.3bn) worth of the drug, the bulk for government pandemic stockpiles, whilst predicting that government stockpile purchases alone would amount to some SFr1.3bn in the following year. By September 2006, more than 65 governments had ordered stockpiles of Tamiflu, with many developed nations buying in supplies sufficient to

treat 25 to 40 per cent of their populations (Jack 2006). At that time Roche donated five million treatment courses of Tamiflu to WHO for regional stockpiles, invested in new production plants, and launched negotiations with sub-contractors in order to increase production, which was set to reach 400 million treatment courses a year by the end of 2006 (Roche 2006). Similarly, following the WHO's 2009 H1N1 PHEIC declaration, global demand surged, annual Tamiflu sales tripled to be worth over US\$2 billion annually, and sales of Relenza also increased, largely due to reports of emerging resistance to Tamiflu (Goldstein 2009; Jack 2009).

Helen Epstein (2011) usefully draws together a number of major issues relating to both Tamiflu and Relenza. Largely these concern contradictions in evidence relating to the efficacy and safety of the drugs, and the methods that have been used to market them. Regarding the efficacy of Relenza, in 1999 an FDA scientific review panel noted that the drug had little effect on influenza symptoms, seemed to worsen breathing problems in people with asthma, and voted 13 to 4 against approval. Nevertheless, agency chiefs overruled the review panel and approved the drug (Cohen 2009). Regarding Tamiflu, in 2009 researchers working with the Cochrane Collaboration reversed previous findings that the drug could ward off pneumonia and other influenza-related complications. Their meta-analysis of 20 studies showed that Tamiflu offered only mild benefits in terms of duration of symptoms for healthy adults and found no clear evidence that it prevented lower respiratory tract infections or other complications of influenza (Jefferson *et al.* 2009b). In a letter accompanying the paper, which was published in the BMJ, a Roche official stated that the company would make 'full study reports' available to independent researchers, but these were not forthcoming (Smith 2009). The Cochrane authors subsequently published an article 'Possible Harms of Oseltamivir - A Call for Urgent Action' in The Lancet on 17 October 2009 (Jefferson *et al.* 2009a). Similarly, in Japan, where Tamiflu is regularly prescribed for seasonal influenza, accounting for over 60 per cent of global consumption in the early 2000s, estimates suggest that its use results in a fourfold increase in the frequency of hallucinations and other neuropsychiatric side effects in children, leading to events such as suicide (Hama 2008). Similar side effects were noted in the UK in 2009 (Kitching *et al.* 2009), and a 2008 article in the journal Drug Safety, signed by a group of Roche authors, claimed that rats and mice given high doses of Tamiflu showed no ill effects, yet according to studies by Chugai, the Japanese Roche subsidiary, the same dose of Tamiflu killed more than half of the animals, with many exhibiting similar symptoms to those identified in Japanese children (Toovey *et al.* 2008).

Clouds also hang over the route to regulatory approval and methods used to market the drugs. In 1999, whilst the manufacturers of both Relenza and Tamiflu were still seeking approval from government regulators, WHO recommended deploying the drugs to contain a novel influenza outbreak (WHO 1999). Subsequently, with Relenza approved, the FDA gave Tamiflu 'fast-track' status, resulting in lesser scrutiny of the clinical evidence that was made available; and according to the FDA's own review documents, the results of the largest

Tamiflu trial, involving some 1,500 patients, were never analysed in detail. Furthermore, and of particular concern in academic circles, is that much of the published work available on Tamiflu has been shown to be funded by Roche and uncritical. Journal articles have been authored by 'ghost-writers', employed by a subsidiary of a medical publisher specialising in producing brochures and articles for pharmaceutical companies, who did not have access to details of the clinical studies, or data from them (Cohen 2009 *op cit*).

In wider circles, questions have also been raised over the political connections of Gilead Sciences, intellectual property owner of Tamiflu, which receives a 20 per cent royalty on worldwide Tamiflu sales (Zacks Investment Research 2009). Donald Rumsfeld served as chairman from 1997 until 2001 when he joined President Bush's administration, and in 2005 he held shares valued at over US\$5 million. The wife of the former California Governor Pete Wilson has also served on the company's board, as has former US Secretary of State George Shultz, who sold stock worth more than US\$7 million in 2005 (Schwartz 2005). Despite Rumsfeld recusing himself from US government decisions related to anti-viral drug procurement, his connection in particular with the company has led to allegations of undue influence and impropriety.

It might be expected that these manifold and highly critical claims would provoke a detailed rebuttal from the manufacturer, or at least for the company to release the data they hold in full for analysis by independent researchers. It might also be expected that WHO, as an advocate, promoter and distributor of anti-viral drugs, might demand further transparency and analysis. Yet, according to a representative of the Cochrane Collaboration interviewed in early March 2012, this had not yet occurred, and a large question mark must hang over why.⁴²

A specialist medical journalist interviewed points to Roche's secrecy and the fact that anti-viral drugs were writ large in WHO's pandemic planning advice even before they had received regulatory approval as one of the most significant elements underlying the accusation of undue collusion with industry made against WHO in the aftermath of the pandemic:

There was a total lack of transparency, and so the journalists who were looking at the situation ended up saying, 'Oh My God. These people [WHO consultants] have links with this company and that company and have never declared them.'⁴³

Another interviewee offered a further reaching critique:

WHO has amazing convening power and I am astounded that there were not more efforts by WHO and other national and international bodies to

⁴² Interview, London, 1 March 2012

⁴³ Interview, London, 19 December 2011a

fund follow up studies looking at patient outcomes. It would have been possible to quickly create a number of studies looking at the success of different treatment regimes. That was happening incredibly slowly and it is as much a critique of academia as science funding more broadly. It was no surprise that the Roche studies were throwing up more favourable findings. But this isn't necessarily a cynical plot by Roche, it's as much an absence of other work done by other groups.⁴⁴

Another interviewee, with a more global perspective, pointed to the harsh political reality:

It is recognised that vaccine can arrive so late as to be possibly useless, or of limited benefit. So there are only anti-virals really which governments seize on because there is not much they can say or do which seems plausible except for buying anti-virals. This is why they do this. There is nothing else they can do.⁴⁵

To sum up, pharmaceuticals offer an alluring solution to the threat of pandemic influenza. Should an effective vaccine, available in sufficient quantities, be presented to a willing public shortly after the detection of a novel virus, the threat would effectively cease to exist. In this, vaccine stands as a compelling narrative to global and national institutions charged with responsibility for public health. As matters stand, however, vaccine is an elusive solution. It arrives late, in limited quantities, and many people are unwilling to have it administered. Similarly, significant questions stand relating to the efficacy and safety of anti-viral drugs. Again technical and popular framings of the threat and the solutions can be seen to be incongruent, with the narrow framings emerging from a techno-scientific network at odds with the plural and varied requirements of individuals. Uncritical of its own approaches and attitudes, a tight-knit actor network is again unable to adjust technical narratives so that they correspond better with public understandings and concerns, and so finds its credibility undermined. The reductive narrative of a pharmaceutical solution, however, gains further impetus from the shared epistemology of WHO, many national governments, and the pharmaceutical industry. A coalition of scientific and commercial interests occludes the uncertainties of science and of society, and produces and promotes a universalistic and inflexible solution

Furthermore, in 2009-10, with pharmaceuticals largely only available in industrialised nations, WHO's involvement at the centre of narrow, technical construction of the pandemic threat, and the response to it, was easily construed as misapplication of attention, funding and effort on behalf of the high-income countries that most significantly fund the organisation. This issue is taken up in the next section.

⁴⁴ Interview, London, 19 December 2011b

⁴⁵ Interview, Davos, 21 February 2012c

5. Whose world? Whose health?

What we too easily forget in the rich world is that in much of the poor world people live in essentially pandemic conditions all the time. Disease of humans and of livestock is always present. It [H1N1 pandemic influenza] was just another disease among many.⁴⁶

Difficult numbers

Assessing, or even estimating, the number of H1N1 cases and deaths by country or region in 2009-10 with any reliable accuracy is impossible. In the case of both seasonal flu and pandemics, it is well known that many people with flu don't seek medical care, and that only a small proportion of those that do are tested (CDC 2010). Even the numbers of deaths attributed to seasonal influenza - some 500,000 annually - are estimates based on statistical models designed to calculate so-called excess mortality that occurs when influenza viruses are circulating (WHO 2009a). Recognising these factors, along with the consideration that case or mortality numbers could do little to guide the pandemic response, and that in many countries it was consuming valuable laboratory capacity, on 16 July 2009, just five weeks into the 15-month event, WHO announced that countries already experiencing community-wide transmission were no longer required to submit regular reports of individual laboratory-confirmed cases, and the organisation would no longer issue global tables showing the numbers of confirmed cases for all countries (WHO 2009c). Countries were however requested to report their first confirmed cases, and, if feasible, to provide weekly aggregated case numbers, descriptive epidemiology of early cases, and to monitor the virological characteristics of the virus.

Nevertheless, a month before the event was declared over, on 9 July 2010, stressing that the reported, laboratory-confirmed, number of deaths was a significant under representation of actual numbers, WHO presented the table of the regional mortality of the pandemic given in Table 1.

Table 1: Laboratory-confirmed cases of pandemic (H1N1) 2009 as officially reported to WHO by States Parties to the IHR (2005) as of 4 July 2010 (WHO 2010d).⁴⁷

⁴⁶ Interview, Davos, 21 February 2012c

⁴⁷ Approximate population figures (2005) calculated from: http://www.who.int/choice/demography/pop_death_rates/en/index.html [accessed 4 May 2012]. Wikipedia also offers a detailed compilation of official reports, flagged as outdated, at: http://en.wikipedia.org/wiki/2009_flu_pandemic_by_country [accessed 3 May 2012].

Region	Deaths
WHO Regional Office for Africa (AFRO)* (pop. 755 million)	168
WHO Regional Office for the Americas (AMRO) (pop. 884 million)	At least 8,516
WHO Regional Office for the Eastern Mediterranean (EMRO)** (pop. 530 million)	1,019
WHO Regional Office for Europe (EURO) (pop. 855 million)	At least 4,879
WHO Regional Office for South-East Asia (SEARO) (pop. 1.7 billion)	1,883
WHO Regional Office for Western Pacific (WPRO) (pop. 1.7 billion)	1,846
Total	At least 18,311

* Last update 23 May 2010

** Last update 7 March 2010

It is tempting but mistaken to try and read anything significant into this table regarding the impact of the event. Low mortality figures may simply represent low detection rates, and the higher figures for Europe and the Americas may therefore only indicate superior surveillance systems and laboratory capacity. Simply counting deaths, it should also be noted, does not accurately measure impact. Compared to seasonal influenza, the H1N1 virus, like other pandemic viruses, affected a younger age group. Even a year into the event, a meta-analysis of nine seroepidemiological studies concluded that it was not possible to accurately estimate the true global attack rate of the pandemic (WHO 2010b). According to a WHO technical group convened to examine the matter, the fact is that data for a definitive estimate of H1N1 mortality will not exist for several years, and will never exist for some parts of the world (WHO 2011a).

The inequities of flu

This, in itself, is an indication of the inequity currently associated with flu. Very largely, high-income countries have a far superior capacity to surveil for the virus and monitor its effects. For several reasons, however, the dominant narrative concerning inequity in the context of pandemic flu coalesces around pharmaceutical products (Yamada 2009). First, as discussed in the previous section, vaccine and anti-viral drugs have attained undue prominence as a result of the powerful, unreflexive coalition backing them. Anti-viral drugs have also featured prominently in hypothetical containment operations where outbreaks,

usually in poor countries in south-east Asia, are 'ring-fenced' through emergency distributions (cf. Ferguson *et al.* 2005). Second, with vaccine production facilities largely concentrated in high-income countries, and a 1-2 billion dose production capacity that falls well short of that required to protect (even partially) a global population of 7 billion, many high-income countries have long-standing advance purchase agreements with manufacturers which preclude poorer nations from acquiring a timely supply. In 2009, the USA, for example, had contracts in place covering at least 600 million doses (Brown 2009).

Beyond these stark facts, the issue of equitable access to vaccines has attained prominence as a result of Indonesia's withholding of human H5N1 virus samples from WHO's Global Influenza Surveillance Network (GISN) in 2006 and 2007 on the grounds that pharmaceutical companies in industrialised countries obtained free access to such samples, exploited them, and patented the resulting products which developing countries could not then afford (Fidler 2008; Sedyaningsih *et al.* 2008; Fidler 2010). Largely as a result of the upset caused by Indonesia, and the agreements that have resulted from subsequent negotiations, during the 2009-10 event WHO sought vaccine donations from manufacturers and high-income country governments for distribution in low-income countries, and the UN appealed for funding to buy vaccines for free-of-charge distribution (BBC 2009). Subsequently in September 2009, Australia, Brazil, France, Italy, New Zealand, Norway, Switzerland, the UK and the USA made pledges totalling around 300 million doses, but Australia later pressed its national manufacturer to fulfil national demand before exporting, Canada stood back because of national fears of a shortage, and on 28 October, the USA reneged on its commitment (WHO 2009d; Fidler 2010).

Those pledges that were fulfilled, including contributions by manufacturers, were only dispatched once it had become clear that the event was milder than anticipated, and that the looming crisis was one of excess supply rather than a shortage. Had the event been more extreme, and demand for vaccine in industrialised countries higher, it would have been politically difficult for any of these governments to make good on their pledges. One respondent put it starkly:

That's one major point I'd bring out.[...] UNSIC and WHO did work together to try and raise money for vaccines for the least developed countries, but if you look at what vaccines arrived where, and when, UNSIC and WHO clearly did not succeed.⁴⁸

The same respondent, with long-standing experience in global public health, went on to raise an almost heretical question, but one that was implicit in many interviews:

⁴⁸ Telephone interview, 15 December 2011

The expectations, certainly from a developing country perspective, given the current technology, given the current vaccine, to get vaccine to countries when they need it, and to protect the population before the disease arrives, is that really an objective which we should strive for worldwide? I doubt that it is. If we had a different type of vaccine that was available more quickly, if we had greater vaccine production capacity worldwide, then perhaps. But given where we are now, should we even think of that as an objective? There's the challenge of saying of course we have to have equity, but we don't have equity in anything else at the moment, so why should influenza vaccine be special? In a pandemic situation, given the way we produce vaccines, it's probably unattainable, so we are bound to fail. So why do we put that forwards as almost a gold standard?

As discussed above, influenza vaccine, in the absence of alternatives, is arguably 'special' in global health policy making most significantly because of Indonesia's protests. No other countries have followed Indonesia's lead in withholding virus samples, or have threatened to, but even a temporary withdrawal of any countries from WHO's replacement for the GISN, the Global Influenza Surveillance and Response System (GISRS), would weaken the system, and further undermine the principle of global solidarity on which it is based.

With similar objectives towards equity in access to vaccines, since 2006 WHO's Global Action Plan (GAP) for Influenza Vaccines has seen significant efforts to transfer vaccine technology to low- and middle-income countries, and in the five years to 2011, five manufacturers (in India, Indonesia, Korea, Romania and Thailand), of 11 which received WHO seed funding, have produced licensed influenza vaccines (WHO 2012: 1). This approach, however, laudable as it might appear, was also criticised by a number of respondents. One, an industry analyst, said:

On vaccines, I think another slightly misguided line put out by WHO, encouraged by them, is the idea of promoting local production. To me that is not the solution. The fundamental challenge relates to clear long term demand. The drug companies will invest in production - they can produce three or four billion doses - if there was a clear signal that they would be paid for them. But the reality is that most developing countries, even most developed countries outside certain risk groups, don't make that commitment. For years, WHO and others have said we should be giving seasonal flu vaccine to all working adults, the cost/benefit is quite clear, but it doesn't happen. Go to Indonesia, say, and what priority does this have? And the more you produce, the lower the unit cost of course. So instead of developing systems to produce for a bigger market, allowing stability of production at lower cost, there's this tub-thumping exercise involving each country developing its own vaccine plant. That's crazy. A vaccine plant costs 200 to 300 million dollars. It'll take two to three years to build. It'll take you another year to get regulatory approval, and then what

are you going to do if there's no demand? Sit it in mothballs for 15 years until the next pandemic when it'll already be out of date?⁴⁹

Even within WHO it is recognised that equitable access to flu vaccines represents a significant challenge. A respondent inside the organisation said:

Yes we know that we will never produce 7 billion doses. There will never be enough. But in 2009 provision was made for poor countries in a way that it has never been before. This was significant. There's also the GAP programme. But that is just strategy. There are other issues: regulatory capacity, capacity for storage, cold chains and so on. Then there are things like syringe production and disposal, monitoring. It adds up to a big task.⁵⁰

This task would doubtlessly be easier if there was demand from the market, but as has been discussed, even in high-income countries demand for seasonal flu vaccine is variable, particularly outside acknowledged 'at risk' groups (e.g. the elderly, some professional groups, and those with underlying respiratory diseases), especially if the costs of vaccination are to be met by the individual (Mereckiene *et al.* 2008). In low-income countries, where seasonal flu is rarely recognised as a public health issue, demand is even lower, and many poor countries face more significant health challenges. When asked whether better surveillance in low-income countries might show the incidence needed to generate commercial interest and investment, the public health expert quoted above was clear:

We don't have good surveillance data on influenza in non-temperate climates. There are some that come out, but we have no good estimate of mortality, and an even worse understanding of morbidity for influenza in the tropics, and therefore is influenza vaccine a major vaccine that those countries should be looking for? Or are there other more important diseases? I think if all those countries, the BRIC [Brazil, Russian, India, China] countries [...] and other ones like Indonesia, Egypt, actually said yes, this is something that is of major importance for us from a mortality perspective, this is important from the perspective of illness in our country, then they might say we want to work with the manufacturers and develop a vaccine manufacturing capacity. [...] But if you don't have those data, how can you know whether there is really a market or not?⁵¹

Significantly - and self-evidently - flu in tropical regions eludes the seasonal pattern that has shaped global understandings to date, with vaccines formulated and manufactured for the winter flu 'seasons' in the northern and southern hemispheres. A respondent said:

⁴⁹ Interview, London, 19 December 2011b

⁵⁰ Interview, Geneva, 23 February 2012b

⁵¹ Telephone interview, 15 December 2011

... the more we look the more we understand that influenza is a problem in developing countries but there it's all year round; it's not just at certain times of the year. But then nobody has really looked at the mortality of it, we just don't know whether people are dying of it in those regions. When people get a fever in the tropics they often say they have malaria or dengue. Flu generally needs to be better studied, it's just never been really well studied.⁵²

Another respondent pointed to the wider issues:

We know that there are big gaps in global surveillance for influenza, for global epidemiology and virology too. There are technical constraints, but this is more to do with political will, with national interests, and with donor interests. [...] You have to look at what expectations people have of their governments. From a UK perspective, from a western perspective, yes, you'd expect the government to have plans, and to take action. But in Nepal say or in Cameroon, people would not expect this from their government. You can't really say that there is one global view on this. [...] It needs to be recognised too that attitudes, concerns are very different in different countries. In some countries flu is seen as a problem. In others not.⁵³

The current configuration of the planned response to pandemic flu, then, is not only reductive, inflexible and entwined with commerce, but also the product of understandings and concerns of high-income countries in temperate regions. If a reductive scientific framing is confounded by flu's uncertainty in the global North, the problem is compounded by ignorance of the virus and the disease elsewhere, where both may present very different features, and so require a very different set of responses. Given that WHO, and many developed nations, are notionally so keen on equity, some of the gaps in current knowledge are startling. According to UNAIDS, for example, no documented information exists on the clinical interactions between HIV and H1N1, and data to predict the impact of a possible influenza pandemic on people living with HIV are inadequate (UNAIDS 2009).

Today, then, the uncertainty, complexity and ignorance of influenza extend beyond Neustadt and Fineberg's 1978 investigations of events in the USA to include the complexities and uncertainties of global politics and international relations, as well as new diseases. In this wider domain, and considering the needs and means of the world's poorest people, pharmaceutical solutions appear even less viable than they do in high-income countries. Yet poor people in regions where healthcare systems are often weakest are likely to be infected first, and younger - or immunosuppressed - populations are likely to be more vulnerable. As will be discussed next, the viability of public, non-pharmaceutical, interventions in many poor regions is also troubled, and troubling.

⁵² Interview, London, 9 February 2012b

⁵³ Interview, Geneva, 23 February 2012b

Illusions of control

Vaccines and anti-viral drugs are not the only planned response to flu pandemics. 'Non-pharmaceutical interventions' include movement restrictions such as closing borders, quarantining infected people and their contacts, and 'social distancing' measures such as prohibiting, or avoiding, mass gatherings, and closing transit systems, schools and childcare centres. Quantifying the effects of such measures is tricky, given the difficulties previously discussed of determining almost any reliable numbers regarding the impact of flu. Similarly, interventions based on improved personal hygiene such as wearing masks, regular hand washing or disinfection, and cough and sneeze etiquette, are based more on plausible effectiveness than controlled studies (WHO Writing Group 2006). The literature contains a dearth of evidence on the effectiveness of non-pharmaceutical interventions (Aledort *et al.* 2007). Nevertheless in the critical five or six months before a vaccine becomes available, if the limited effectiveness of anti-viral drugs is accepted, these relatively simple measures represent the entirety of the world's response to pandemic flu.

Even if such methods won't stop a pandemic in its tracks, they can usefully delay pandemic peaks, staggering them so as to reduce the most intense pressures on healthcare and other public services. Many governments are however loathe to deploy the most extreme measures. Movement controls are unpopular, any enforcement of quarantine is easily perceived as authoritarian, and closing schools is disruptive. Few governments are prepared to disregard the wider effects on the economy of such measures either. In 2009, as one respondent explained: 'They [national governments] were very cautious, never jumped to go down that route. They were trading the health risks off against the economic drag'.⁵⁴ Accepting that, and setting pharmaceuticals aside, the only available response to pandemic flu appears to boils down to the most basic matters of individual personal hygiene.

At first glance, these 'non-pharma' responses might appear to offer the possibility of a more equitable global approach. More considered inspection however quickly reveals that these measures, like pharmaceutical interventions, offer more benefit in the rich world than in the poor. Respondents were succinct on this matter. One said:

... we are left with social distancing and hand washing but these are really rich world solutions for people with places they can go to be more or less alone, and with running water and soap. These are the basics, but not everyone has them and it is easy to forget that.⁵⁵

⁵⁴ Interview, London, 19 December 2011b

⁵⁵ Interview, Davos, 21 February 2012b

Another said:

On hand washing and school closures and distancing, I'd just say that all the models, the CDC models, are based on behaviour in very highly developed countries. They may not stand up at all in the developing world, especially in big cities.⁵⁶

And another said:

Social distancing is the one tool everyone has. As soon as you feel there might be a pandemic, you want to close your public gatherings. And that any country can do, including poor countries such as India say. But they will have a more difficult time because if a person takes the virus home, they will probably spread it to ten rather than two or three people.⁵⁷

And yet another said:

Social distancing is not going to work in all sorts of poor countries. And the poor there are not going to get the anti-virals or the vaccine unless they are really lucky. It's all a sort of wishful panacea that is not going to work.⁵⁸

Even in developed countries it is accepted that it is easier to promote non-pharma interventions than it is to actually get them practised. Regarding the 2009-10 event, a respondent said:

It might be said that we did not do so well on non-pharma interventions. This is probably because not enough was done before in preparation. It's very difficult to get that sort of response going from a standing start.⁵⁹

Equity in any pandemic response, then, is as challenging, and as challenged, an issue as equity concerning many other global matters. Should a lethal flu virus reach Mumbai, say, or Jakarta, it will very likely cause more severe illness and deaths and than in Los Angeles or Paris; and in Mumbai or Jakarta, with younger populations, it will be the poorest people, most densely packed, furthest from running water, and possibly suffering a higher prevalence of other illnesses, who will be most badly affected. A picture of such massive urban populations panicking and rushing to the countryside, along with the force needed to dissuade them, does not bear consideration. As every respondent indicated when asked about the matter, equity in the case of a severe flu pandemic, in the shape of access to vaccines or anti-viral drugs, advanced medical care such as respiratory ventilation, or non-pharmaceutical interventions, is illusory.

⁵⁶ Interview, Davos, 21 February 2012c

⁵⁷ Interview, London, 9 February 2012b

⁵⁸ Interview, Geneva, 23 February 2012a

⁵⁹ Interview, Davos, 22 February 2012c

Yet the scientific-commercial-bureaucratic network directing the global response remains fixated on a universalistic solution that allows little consideration for plural, variegated alternative responses. As has been discussed above, this causes manifold problems within nations. Globally, the case to encourage more plural approaches appears even more convincing. One respondent suggested:

I don't think it is well enough recognised that the event played out in different ways [...] in different parts of the world. In spring 2009 for example it was more or less a non-event in Latin America - Brazil, Argentina - but then they got hit later. I don't think you'd find many people in Argentina now for example who'd agree with the suggestion that it was a bit of a non-event.⁶⁰

Another said:

... even in the EU we know now that there are very different patterns between different countries, and in Vietnam, for example, we know that there are contacts between toddlers and elderly grandparents much more often than you'd see in Europe.⁶¹

And another said:

The issue though, even if it's a pandemic - by definition global - is that it needs to be recognised that it is not the same across the globe. [...] It comes back to this ideal that we should have consistent approaches globally, and we don't seem to have an environment where differences across the globe - between countries and within countries - is recognised as a matter of fact, and accepted in our planning. [...] But that's a tough, ethical decision. It's an ethical debate too about what WHO should do in one country as opposed to another, and I don't think there's an easy answer. But the big issue is that we have not had the debate. [...] The problem is - in terms of equity - can we live with a strategy which is different from country to country, and especially between the developed and the less developed world? Can we live with a policy that does not seem to be equitable? I think that this is a debatable question.⁶²

It is hard if not impossible for WHO to convene, or even sanction, such a debate. Aside from its central position in an unreflexive scientific actor network, the organisation's constitution obliges it to extend 'to all peoples [...] the benefits of medical, psychological and related knowledge' (WHO 2006: 1). Thus, if high-income countries have access to vaccine and anti-viral drugs, why should WHO not make every effort to provide the same for poorer, less developed countries?

⁶¹ Interview, Davos, 21 February 2012c

⁶² Interview, Geneva, 23 February 2012b

⁶³ Telephone interview, 15 December 2011

This is Indonesia's requirement at least. Rhetorically, moves were made during the 2009-10 event to fulfil this demand, but too little happened too late, and had there been pressing demand in high-income countries, the response in support of poorer countries would have been even more underwhelming. In the longer term, particularly with respect to the development of manufacturing capacity, provision of pandemic vaccine also fails when linked with provision of seasonal vaccine, which again can only ultimately work against the world's poorest people. Underpinned by large gaps in bio-medical knowledge regarding the incidence and impact of flu in poor countries in tropical regions, and exemplified by the lesser effects of non-pharmaceutical interventions there, any discussions around equity given the current configuration of the global response only emphasises its stark absence.

The world, however, doubtlessly needs a coordinating technical agency to play a role across borders in the case of influenza pandemics and other international health threats, and provide, as much as possible, unbiased and impartial guidance, expertise and assistance when required. For now, and the next decade at least, this agency will be WHO. The conclusion that follows suggests that the world would be better protected from flu by a re-ordering of pandemic preparedness and response efforts around global equity. Such a re-ordering might refresh and refocus WHO, allow it to regain public credibility and authority, and avoid such global political tangles as emerged during the 2009-10 event.

6. Conclusion: publics and health

This paper has argued that globally, and in many individual nations, technoscientific narratives constructed by bio-medical actor networks responsible for responding to the 2009-10 pandemic failed to correspond with more plural and variegated narratives constructed by multifarious publics, and so struggled to recruit support. With public understandings and concerns at variance from those of global and national health authorities, the credibility of those authorities suffered. Contestations over naming showed that the ramifications of the event went beyond reductive bio-medical constructions, and attempts to suppress narratives implicating a specific region, or species, as involved in the genesis of the event tellingly illustrate the political influence of wider networks.

Similarly political debates arose around the definition of the term 'pandemic', with many real world experiences at odds with the inflexible, reductive determinations of bio-medical science; and the failure of pharmaceuticals, a potent narrative of the universalist bio-medical response, cast further doubt over the competence and authority of expert prescriptions. Normative attempts to address global equity in the response served more to emphasise the gap between the rich and the poor, than to narrow or close it, and made it even plainer that a one-size-fits-all technical solution is insufficient in the uncertain circumstances flu presents. Few retrospective evaluations have investigated the pathology of this situation. 'Luck', in the form of a virus that was not particularly lethal, is not a reassuring explanation for what many present as a relatively satisfactory state of affairs.

Today, then, influenza is no less 'slippery' than in 1976, when Neustadt and Fineberg examined it in the USA. Expert knowledge is still speculative and incomplete, and politicians and the public are still only tangentially and unpredictably engaged. For this paper, the primary scandal associated with the 2009-10 pandemic is not the epistemic collusion that inevitably arose between the understandings and interests of health authorities and commercial networks, which so exercised the Council of Europe, but the fact that so little has changed since 1976.

In answer to the first major policy question set in the 1978 report - How should politicians and non-expert officials address matters that depend on complex and technical, but speculative and incomplete, expert knowledge? - this paper suggests they, and the bio-medical actor networks that construct them, must recognise that reductive scientifically-defined understandings and responses are insufficient in the conditions of uncertainty that flu presents, and may be misguided. If this is recognised, cultural, political and commercial forces can be accepted as influential and judged on their merits, and a wider range of understandings and responses might be considered. If not, particularly if the fundamental uncertainty, complexity and ignorance of flu is further denied or occluded, the world appears to be faced only with more of the same, which will only erode further the authority and credibility of the responsible institutions.

The persistence of a dominant reductive framing probably constitutes the most significant challenge of responding to flu effectively. In conditions of uncertainty, reliance on a reductive epistemological framing does not only risk producing narrow, and easily confounded, responses, but also excludes and suppresses alternative, and possibly complementary, solutions. Therefore, in answer to the second major policy question of the 1978 report - How should the public be involved in such matters, and how can they be debated given the type of complicated and technical issues at play? - this paper suggests that a significant first step is to make determined moves not to exclude the public, or alternative framings. If uncertainty is accepted, alternatives have the chance to emerge. If global publics - a wide range of different groups and individuals spread across the planet - are to be more effectively engaged in both delaying the next pandemic and preparing for it, then bio-medicine's determination to define the problem, and the pathways of response, needs to be loosened. People need to be able to define the problem and responses to it in their own terms.

More specifically, a more plural approach would allow a more robust discussion concerning the suppression of narratives concerning the involvement of livestock and agricultural systems in the genesis of the 2009-10 event. The dominance, and limited scope, of bio-medical narratives has allowed this factor to be occluded. A charged question that then emerges is who or what can interrogate, let alone align, the complex technical, political and business interests, ranging from the livelihoods of poor smallholder farmers to the operations of billion-dollar transnational corporations, that are involved in contemporary agricultural practices? This is not a role WHO is constituted or equipped to play. Despite determined moves over the last five years to integrate human, animal and environmental health, animals, farming practices, and zoonotic diseases such as flu associated with them, still elude the determined attention of bio-medical networks.

A more plural approach would also allow the pre-eminence of pharmaceuticals in the response to be examined, especially their viability in a globally equitable response. Most particularly with flu, especially in the expensive and emotionally charged business of responding to pandemics, the murky cloud that surrounds anti-viral drugs, created by Roche's withholding of data on Tamiflu, needs to be swept away (cf. Doshi and Jefferson 2012). Further issues associated with who gets any vaccine, when, and why also need public examination and debate.

With a normative orientation, WHO should be better placed to address these matters, but bound by a reductive epistemology, and at the centre of an unreflexive, self-sustaining actor network, the organisation is challenged at the highest levels. Change is required however: maintaining the status quo only risks the organisation losing further credibility and authority, and not just with global publics. Some countries have now disassociated their response activities from WHO's pandemic phases, and across Europe at least, preparedness and response plans look set to diverge (Nicoll *et al. op cit*). Charged with responsibility for global health, the danger for WHO is that when preparing for and responding to influenza, it fails the 'world' intrinsic to its name.

One possible route into the complex politics associated with provoking and managing change in these uncertain circumstances, for WHO and other authorities, might be a re-ordering of efforts around a reconfigured understanding of global equity. As matters stand, scientific understandings of flu are drawn almost entirely from temperate regions, and current responses favour high-income countries over low-income ones. Accepting this would allow recognition that equity - in the shape of both access to pharmaceuticals and the effectiveness of non-pharmaceutical interventions - appears at best distant, and at worst impossible given the current configuration of interests. It would also allow an important focus to be drawn on contemporary agricultural practices, which are increasingly exposing the world's poorest people first to novel influenza viruses (and other pathogens, some as yet unknown), and disease surveillance in animals. A re-ordering around equity would also enable a broadening of research efforts to include more socio-economic and interdisciplinary work. Bio-medical investigations rarely go beyond bio-medical matters, and the problem of flu, affecting many different people in many different ways, is doubtlessly more than a bio-medical one.

Recognising this is imperative for the technically-orientated and commercially-driven actor networks that promote reductive solutions if more plural responses are not to be suppressed, and people are to be more effectively engaged. In a world of fast changing global agendas and mandates this will involve different, possibly surprising, forms of engagement, ideally with more emphasis placed on the idea of sustainable responses which are appropriate to location and driven by local needs. In this, the varied attitudes and actions of the BRIC countries, along with others such as Indonesia, might generate the more plural responses a multipolar world both requires and provides.

Potentially affecting everyone, but few of them catastrophically, pandemic flu - which for some manifests as a prosaic few days in bed, and for others as the latest weapon of international terrorism - involves so many concerns and interests that universalistic one-size-fits-all solutions are unlikely to be sufficient, or acceptable. Confronting the coalition of scientific, bureaucratic and commercial interests that benefits from a reductive, universalistic response that fails to meet the varied understandings, needs, and situations of different publics in different parts of the world is essential. People and their priorities and politics vary across the globe, even if pathogens do not. Mixing the uncertainties of science with people, power and politics, perhaps the only certainty with influenza is that there is no single optimal solution. Plural response pathways may not just be inevitable, they may be most effective.

Annexes

1. WHO pandemic phases

Phases	Description
One	No animal influenza virus circulating among animals has been reported to cause infection in humans.
Two	An animal influenza virus circulating in domesticated or wild animals is known to have caused infection in humans and is therefore considered a specific potential pandemic threat.
Three	An animal or human-animal influenza reassortant virus has caused sporadic cases or small clusters of disease in people, but has not resulted in human-to-human transmission sufficient to sustain community-level outbreaks.
Four	Human-to-human transmission of an animal or human-animal influenza reassortant virus able to sustain community-level outbreaks has been verified.
Pandemic	
Five	The same identified virus has caused sustained community level outbreaks in two or more countries in one WHO region.
Six	In addition to the criteria defined in Phase 5, the same virus has caused sustained community level outbreaks in at least one other country in another WHO region.
Post-peak	Levels of pandemic influenza in most countries with adequate surveillance have dropped below peak levels.
Possible new wave	Level of pandemic influenza activity in most countries with adequate surveillance rising again.
Seasonal influenza	
Post-pandemic	Levels of influenza activity have returned to the levels seen for seasonal influenza in most countries with adequate surveillance.

Adapted from 'Pandemic influenza preparedness and response: a WHO guidance document (2009)'

2. WHO Emergency Committee Members

- Dr Lawson Ahadzie - Former Head of Surveillance Department, Ghana Health Service/Ministry of Health, Accra, Ghana (Dr Ahadzie's membership was suspended after the fifth Emergency Committee Meeting on becoming a WHO staff member)
- Mr André Basse - Counsellor, Embassy of Senegal, Paris, France
- Dr Muhammad Akbar Chaudhry - Principal, Professor of Medicine, Fatima Jinnah Medical College, Lahore, Pakistan (Dr Chaudry's membership commenced with the sixth Emergency Committee Meeting)
- Dr Supamit Chunssuttiwat - Senior Expert in Disease Control, Department of Disease Control, Ministry of Public Health, Bangkok, Thailand
- Dr Nancy Cox - Director, Influenza Division, Centers for Disease Control and Prevention, Atlanta, USA
- Dr Anthony Evans - Chief, Aviation Medicine Section, International Civil Aviation Organization, Montreal, Canada
- Professor John Mackenzie - Professor of Tropical Infectious Diseases, Division of Health Sciences, Curtin University, Perth, Australia
- Professor Arnold Monto - Professor, Department of Epidemiology, University of Michigan, Ann Arbor, USA
- Dr Fernando Otaiza - Coordinator, National Infection Control Program, Ministry of Health, Santiago, Chile
- Dr Rogelio Pérez Padilla - Director General, Instituto Nacional de Enfermedades Respiratorias 'Ismael Cosío Villegas', Mexico City, Mexico
- Dr Wing Hong Seto - Chief of Service, Department of Microbiology, Queen Mary Hospital, Hong Kong Special Administrative Region, China
- Dr Masato Tashiro - Director, Department of Viral Diseases and Vaccine Control, National Institute of Infectious Diseases, Tokyo, Japan
- Dr Claude Thibeault - Consultant in Aviation Medicine and Occupational Health, Montreal, Canada

- Dr John Wood - Principal Scientist, Division of Virology, National Institute for Biological Standards and Control, Herts, United Kingdom
- Professor Maria Zambon - Head of Respiratory Virus Unit, Virus Reference Department, Health Protection Agency, Centre for Infection, London, United Kingdom

One advisor to the Emergency Committee was listed:

- Professor Neil M. Ferguson - MRC Centre for Outbreak Analysis and Modelling, Department of Infectious Disease Epidemiology, Imperial College London, United Kingdom

Declared interests included:

- Dr Nancy Cox - Her public health and surveillance research unit at the US Centers for Disease Control & Prevention (CDC) receives financial support from IFPMA for activities of CDC as a WHO Collaborating Centre in the field of influenza vaccine research and virus isolation work.
- Professor Arnold Monto - He declared current and past consultancies in the field of pandemic and/or seasonal influenza for GSK, Novartis, Roche, Baxter and Sanofi. The remuneration for each of these consultancies is below US\$10,000. In addition, his research unit at the University of Michigan has received a grant from Sanofi Pasteur for a clinical trial conducted in 2007-2008 on the comparative efficacy of inactivated and live attenuated influenza vaccines.
- Dr Claude Thibeault - Since 2004, he is the Consultant Medical Advisor to International Air Transport Association.
- Dr John Wood - His research unit at the National Institute for Biological Standards and Control (NIBSC), a centre of the UK Health Protection Agency, has performed contract research for Sanofi Pasteur, CSL, IFPMA, Novartis and Powdermed in the field of influenza vaccine research and development.
- Professor Maria Zambon - The UK Health Protection Agency Centre for Infection receives funding from vaccine manufacturers, including Sanofi, Novartis, CSL, Baxter and GSK, for contract work in Dr Zambon's laboratory.
- Professor Neil M. Ferguson (Advisor) - He has acted as a consultant for Roche, Novartis and GSK Biologicals (ceasing in 2007), with total remuneration from all such work being under US\$7,000 in 2007.

Source: http://www.who.int/ihr/emerg_comm_members_2009/en/index.html

References

- Akan, H., Gurol, Y., Izbirak, G., Ozdatli, S., Yilmaz, G., Vitrinel, A. and Hayran, O. (2010) 'Knowledge and attitudes of university students toward pandemic influenza: a cross-sectional study from Turkey', *BMC Public Health* 10: 413-420
- Alcabes, P. (2009) *Dread*, New York: PublicAffairs
- Aledort, J. E., Lurie, N., Wasserman, J. and Bozzette, S. A. (2007) 'Non-pharmaceutical public health interventions for pandemic influenza: an evaluation of the evidence base', *BMC Public Health* 7: 208-216
- American Public Health Association [APHA] (2003) 'Precautionary Moratorium on New Concentrated Animal Feed Operations', Accessed 4 February, 2012 from <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1243>
- Arda, B., Durusoy, R., Yamazhan, T., Sipahi, O. R., Tasbakan, M., Pullukcu, H., Erdem, E. and Ulusoy, S. (2011) 'Did the pandemic have an impact on influenza vaccination attitude? A survey among health care workers', *BMC Infectious Diseases* 11: 87
- Baker, M. and Fidler, D. P. (2006) 'Global Public Health Surveillance under New International Health Regulations', *Emerging Infectious Diseases* 1.2: 1058-1065
- Bone, A., Guthmann, J. P., Nicolau, J. and Levy-Bruhl, D. (2010) 'Population and risk group uptake of H1N1 influenza vaccine in mainland France 2009-2010: results of a national vaccination campaign', *Vaccine* 28.51: 8157-8161
- Bonneux, L. and Van Damme, W. (2010) 'Preventing iatrogenic pandemics of panic. Do it in a NICE way', *British Medical Journal* 340: c3065
- British Broadcasting Corporation [BBC] (2009) 'Poorer nations get swine flu jabs', *BBC News*, 12 October. Accessed 8 February, 2012 from <http://news.bbc.co.uk/1/hi/8302416.stm>
- Brown, D. (2009) 'Most of Any Vaccine for New Flu Strain Could Be Claimed by Rich Nations' Preexisting Contracts', *Washington Post*, 7 May. Accessed 11 February, 2012 from <http://www.washingtonpost.com/wp-dyn/content/article/2009/05/06/AR2009050603760.html>
- Brown, T. M., Cueto, M. and Fee, E. (2006) 'The World Health Organization and the Transition From "International" to "Global" Public Health', *American Journal of Public Health* 96.1: 62-72
- Brownlee, S. and Lenzer, J. (2009) 'Does the Vaccine Matter?', *The Atlantic Online*, November. Accessed 7 September, 2011 from <http://www.theatlantic.com/doc/200911/brownlee-h1n1>
- Butler, D. (2010) 'Flu experts rebut conflict claims', *Nature* 465.7299: 672-673

- (2012) 'Flu surveillance lacking', *Nature* 483.7391: 520–522
- Callon, M. (1986) 'Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay', in J. Law (ed) *Power, Action and Belief: A New Sociology of Knowledge?*, London: Routledge: 196-260
- (1991) 'Techno-economic Networks and Irreversibility', in J. Law (ed) *A Sociology of Monsters: Essays on Power, Technology and Domination*, London: Routledge: 132-164
- Canadian Senate Committee on Social Affairs Science and Technology (2010) 'Canada's response to 2009's H1N1 influenza pandemic', Accessed 4 March, 2012 from http://www.parl.gc.ca/Content/SEN/Committee/403/soci/SubsiteDec10/Report_Home-e.htm
- Centers For Disease Control And Prevention [CDC] (2009) 'Update: Novel Influenza A (H1N1) Virus Infection - Mexico, March-May, 2009', 5 June. Accessed 23 August, 2011 from <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5821a2.htm>
- (2010) '2009 H1N1: Overview of a Pandemic - Impact of 2009 H1N1', Accessed 19 February, 2012 from <http://www.cdc.gov/h1n1flu/yearinreview/yir5.htm>
- Chor, J. S., Pada, S. K., Stephenson, I., Goggins, W. B., Tambyah, P. A., Clarke, T. W., Medina, M., Lee, N., Leung, T. F., Ngai, K. L., Law, S. K., Rainer, T. H., Griffiths, S. and Chan, P. K. (2011) 'Seasonal influenza vaccination predicts pandemic H1N1 vaccination uptake among healthcare workers in three countries', *Vaccine* 29.43: 7364-7369
- Chuang, J.-H., Huang, A. S., Huang, W.-T., Liu, M.-T., Chou, J.-H., Chang, F.-Y. and Chiu, W.-T. (2012) 'Nationwide Surveillance of Influenza during the Pandemic (2009–10) and Post-Pandemic (2010–11) Periods in Taiwan', *PLoS ONE* 7.4: e36120
- Center for Infectious Disease Research and Policy [CIDRAP] (2009) 'Global agencies want "swine" out of virus's name', *CIDRAP News*, 30 April. Accessed 20 August, 2011 from <http://www.cidrap.umn.edu/cidrap/content/influenza/panflu/news/apr3009fluname.html>
- (2010) 'News Scan: Flu experts weigh in on vaccine production, H5N1 threat', *CIDRAP News*, 7 September. Accessed 24 August, 2011 from <http://www.cidrap.umn.edu/cidrap/content/bt/plague/news/sep0710newsscan-br.html>
- Cohen, D. (2009) 'Complications: tracking down the data on oseltamivir', *British Medical Journal* 339: b5387
- Cohen, D. and Carter, P. (2010) 'WHO and the pandemic flu "conspiracies"', *British Medical Journal* 340: c2912

- Council of Europe (2010) 'The handling of the H1N1 pandemic: more transparency needed', *Verbatim report of the 24 June 2010 Council of Europe Ordinary Session*, Accessed 14 August, 2011 from <http://www.assembly.coe.int/Main.asp?link=/Documents/Records/2010/E/1006241500E.htm>
- Council of the European Union (2010) 'Council conclusions on lessons learned from the A/H1N1 pandemic: health security in the European Union.', Accessed 22 August, 2011 from <http://register.consilium.europa.eu/pdf/en/10/st12/st12665.en10.pdf>
- Dawood, F. S., Iuliano, A. D., Reed, C., Meltzer, M. I., Shay, D. K., Cheng, P.-Y., Bandaranayake, D., Breiman, R. F., Brooks, W. A., Buchy, P., Feikin, D. R., Fowler, K. B., Gordon, A., Hien, N. T., Horby, P., Huang, Q. S., Katz, M. A., Krishnan, A., Lal, R., Montgomery, J. M., Mølbak, K., Pebody, R., Presanis, A. M., Razuri, H., Steens, A., Tinoco, Y. O., Wallinga, J., Yu, H., Vong, S., Bresee, J. and Widdowson, M.-A. (2012) 'Estimated global mortality associated with the first 12 months of 2009 pandemic influenza A H1N1 virus circulation: a modelling study', *The Lancet Infectious Diseases* 12.9: 687-695
- Dehner, G. (2010) 'WHO Knows Best? National and International Responses to Pandemic Threats and the "Lessons" of 1976', *Journal of the History of Medicine and Allied Sciences* 65.4: 478-513
- Del Campo, M. T., Miguel, V. J., Susana, C., Ana, G., Gregoria, L. and Ignacio, M. F. (2011) '2009-2010 seasonal and pandemic A (H1N1) influenza vaccination among healthcare workers', *Vaccine* 29.20: 3703-3707
- Doerr, H., Allwinn, R. and Cinatl, J. (2009) 'Against the new H1N1 influenza (swine influenza): Vaccinate or don't vaccinate (all)? That is currently the question!', *Infection* 37.5: 379-380
- Doshi, P. (2009) 'Calibrated response to emerging infections', *British Medical Journal* 339: b3471
- (2011) 'The elusive definition of pandemic influenza', *Bulletin of the World Health Organization* 89: 532-538
- Doshi, P. and Jefferson, T. (2012) 'Drug Data Shouldn't Be Secret', *New York Times*, 10 April. Accessed 9 May, 2012 from http://www.nytimes.com/2012/04/11/opinion/drug-data-shouldnt-be-secret.html?_r=1
- Dry, S. and Leach, M. (eds) (2010) *Epidemics: Science, Governance and Social Justice*, London: Earthscan
- Enserink, M. (2009) 'Swine Flu Names Evolving Faster Than Swine Flu Itself', *Science*, 8 May. Accessed 19 August, 2011 from <http://news.sciencemag.org/scienceinsider/2009/05/swine-flu-names.html>

- Epstein, H. (2011) 'Flu Warning: Beware the Drug Companies!', *New York Review of Books*, 12 May. Accessed 27 January, 2012 from <http://www.nybooks.com/articles/archives/2011/may/12/flu-warning-beware-drug-companies/?pagination=false>
- Eurich, D. T., Marrie, T. J., Johnstone, J. and Majumdar, S. R. (2008) 'Mortality reduction with influenza vaccine in patients with pneumonia outside "flu" season: pleiotropic benefits or residual confounding?', *American Journal of Respiratory and Critical Care Medicine* 178.5: 527-533
- Europa (2009) 'EU steps up action on novel flu virus', 30 April. Accessed 23 August, 2011 from <http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/687&format=HTML>
- European Centre for Disease Prevention and Control [ECDC] (2009) 'Report of considerably increased global capacity for production of seasonal and pandemic vaccine – reports of a WHO Survey May 2009', Accessed 2011, 3 September from http://ecdc.europa.eu/en/activities/sciadvice/Lists/ECDC%20Reviews/ECDC_DispForm.aspx?List=512ff74f-77d4-4ad8-b6d6-bf0f23083f30&ID=637&MasterPage=1
- Evans, M. R. (2010) 'The swine flu scam?', *Journal of Public Health* 32.3: 296-297
- Ferguson, N. M., Cummings, D. A. T., Cauchemez, S., Fraser, C., Riley, S., Meeyai, A., Iamsirithaworn, S. and Burke, D. S. (2005) 'Strategies for containing an emerging influenza pandemic in Southeast Asia', *Nature* 437.7056: 209
- Fidler, D. P. (1996) 'Globalization, International Law, and *Emerging Infectious Diseases*', *Emerging Infectious Diseases* 2.2: 77-84
- Fidler, D. P. (2008) 'Influenza Virus Samples, International Law, and Global Health Diplomacy', *Emerging Infectious Diseases* 14.1: 88-94
- Fidler, D. P. (2010) 'Negotiating Equitable Access to Influenza Vaccines: Global Health Diplomacy and the Controversies Surrounding Avian Influenza H5N1 and Pandemic Influenza H1N1', *PLoS Med* 7.5: e1000247
- Fidler, D. P. and Gostin, L. O. (2006) 'The New International Health Regulations: An Historic Development for International Law and Public Health', *The Journal of Law, Medicine & Ethics* 34.1: 85-94
- Food and Agriculture Organization [FAO] (2009) 'FAO states that the new A/ H1N1 virus has not been detected in pigs', 30 April. Accessed 25 August, 2011 from <http://www.fao.org/news/story/en/item/19335/icode/>
- Gidengil, C. A., Parker, A. M. and Zikmund-Fisher, B. J. (2012) 'Trends in Risk Perceptions and Vaccination Intentions: A Longitudinal Study of the First Year of the H1N1 Pandemic', *American Journal of Public Health* 102.4: 672-679

- Gilchrist, M. J., Greko, C., Wallinga, D. B., Beran, G. W., Riley, D. G. and Thorne, P. S. (2006) 'The Potential Role of Concentrated Animal Feeding Operations in Infectious Disease Epidemics and Antibiotic Resistance', *Environmental Health Perspectives* 115.2:313-316
- Goldstein, S. (2009) 'Roche hikes profit goal as Tamiflu sales triple', *Wall Street Journal MarketWatch*, 23 July. Accessed 6 February, 2012 from http://articles.marketwatch.com/2009-07-23/industries/30704506_1_roche-shares-tamiflu-sales-genentech
- GRAIN (2010) 'Remembering La Gloria', Accessed 18 August, 2011 from <http://www.grain.org/article/entries/202-remembering-la-gloria>
- Greger, M. (2009) 'CDC Confirms Ties to Virus First Discovered in U.S. Pig Factories', *Humane Society of the United States*, 29 April. Accessed 27 August, 2011 from http://www.humanesociety.org/news/news/2009/04/swine_flu_virus_origin_1998_042909.html
- Haas, P. M. (1989) 'Do Regimes Matter? Epistemic Communities and Mediterranean Pollution Control', *International Organizations* 43.3: 377-403
- (1992) 'Epistemic Communities and International Policy Coordination', *International Organizations* 46(1): 1-35
- Hama, R. (2008) 'Fatal neuropsychiatric adverse reactions to oseltamivir: Case series and overview of causal relationships', *International Journal of Risk & Safety in Medicine* 20: 5-36
- Henrich, N. and Holmes, B. (2009) 'The public's acceptance of novel vaccines during a pandemic: a focus group study and its application to influenza H1N1', *Emerg Health Threats J* 2: e8
- Heymann, D. L. (2006) 'SARS And Emerging Infectious Diseases: A Challenge To Place Global Solidarity Above National Sovereignty', *Annals of the Academy of Medicine, Singapore* 35: 350-353
- Hine, D. (2010) 'The 2009 Influenza Pandemic - An independent review of the UK response to the 2009 influenza pandemic', Accessed 2 August, 2011 from <http://www.cabinetoffice.gov.uk/media/416533/the2009influenzapandemic-review.pdf>
- International Federation of Red Cross and Red Crescent Societies [IFRC] (2009) 'Your best defence is you', Accessed 28 August, 2011 from <http://www.ifrc.org/en/what-we-do/health/diseases/pandemic-influenza/your-best-defence-is-you/>
- Jack, A. (2006) 'Feeling the Strain', *Financial Times*, 2 September. Accessed 7 February, 2012 from <http://www.ft.com/cms/s/0/53c28e70-3a1f-11db-90bb-0000779e2340.html#ixzz1VpFYRjAf>
- (2009) 'Roche and Glaxo team up to test rival swine flu drugs', *Financial Times*, 8 September. Accessed 8 February, 2012 from <http://www.ft.com/cms/s/0/70e33e1a-9c0e-11de-b214-00144feabdc0.html#axzz22CIOOT00>

- Jasanoff, S. (1990) *The Fifth Branch: Science Advisors As Policymakers*, Cambridge, Mass: Harvard University Press
- Jasanoff, S. (2004) *States Of Knowledge: The Co-Production Of Science And Social Order*, London: Routledge
- Jefferson, T., Jones, M., Doshi, P. and Del Mar, C. (2009a) 'Possible harms of oseltamivir? A call for urgent action', *The Lancet* 374.9698: 1312-1313
- (2009b) 'Neuraminidase inhibitors for preventing and treating influenza in healthy adults: systematic review and meta-analysis', *British Medical Journal* 339: b5106
- Jimenez-Jorge, S., de Mateo, S., Pozo, F., Casas, I., Garcia Cenoz, M., Castilla, J., Gallardo, V., Perez, E., Vega, T., Rodriguez, C., Quinones, C., Martinez, E., Gimenez, J., Vanrell, J., Castrillejo, D., Serrano, M., Ramos, J. and Larrauri, A. (2012) 'Early estimates of the effectiveness of the 2011/12 influenza vaccine in the population targeted for vaccination in Spain, 25 December 2011 to 19 February 2012', *Euro Surveillance* 17.12: pii=20129
- Kaplan, M. M. (1980) 'The Role of the World Health Organization in the Study of Influenza', *Philosophical Transactions of the Royal Society B; Biological Sciences* 288.1029: 417-421
- Keeley, J. and Scoones, I. (2003) *Understanding Environmental Policy Processes*, London: Earthscan
- Kitching, A., Roche, A., Balasegaram, S., Heathcock, R. and Maguire, H. (2009) 'Oseltamivir adherence and side effects among children in three London schools affected by influenza A(H1N1)v, May 2009 – an internet-based cross-sectional survey', *Euro Surveillance* 14.30: pii=19287
- Lancet editors (2010) 'Pandemic influenza? (some) reasons to be cheerful?', *The Lancet* 376.9741: 565
- Latour, B. (1996) *Aramis, or the love of technology*, Cambridge, Mass: Harvard University Press
- Law, J. (1986) 'On the Methods of Long Distance Control: Vessels, Navigation and the Portuguese Route to India', in J. Law (ed) *Power, Action and Belief: A New Sociology of Knowledge*, Henley: Routledge: 234-263
- Leach, M. and Fairhead, J. (2007) *Vaccine anxieties: global science, child health and society*, London: Earthscan
- MacKenzie, D. (2009) 'Deadly new flu virus in US and Mexico may go pandemic', *New Scientist*, 27 May. Accessed 5 August, 2010 from <http://www.newscientist.com/article/dn17025-deadly-new-flu-virus-in-us-and-mexico-may-go-pandemic.html>
- Mak, D. B., Daly, A. M., Armstrong, P. K. and Effler, P. V. (2010) 'Pandemic (H1N1) 2009 influenza vaccination coverage in Western Australia', *Medical Journal of Australia* 193.7: 401-404

- Maltezou, H. C., Dedoukou, X., Patrinos, S., Maragos, A., Poufta, S., Gargalianos, P. and Lazanas, M. (2010) 'Determinants of intention to get vaccinated against novel (pandemic) influenza A H1N1 among health-care workers in a nationwide survey', *The Journal of Infection* 61.3: 252-258
- Mansnerus, E. (2009) 'The Lives of "Facts" in Mathematical Models: A Story of Population-level Disease Transmission of Haemophilus Influenzae Type B Bacteria', *BioSocieties* 4(-3): 207-222
- (2010) 'Silence of evidence in the case of pandemic influenza risk assessment', Accessed 4 May, 2012 from <http://www2.lse.ac.uk/researchAndExpertise/units/CARR/pdf/DPs/Disspaper60.pdf>
- McInnes, C. and Lee, K. (2006) 'Health, security and foreign policy', *Review of International Studies* 32.01: 5-23
- McNeil, D. G. (2010) 'U.S. Reaction to Swine Flu: Apt and Lucky', *New York Times*, 1 January. Accessed 24 August, 2011 from http://www.nytimes.com/2010/01/02/health/02flu.html?_r=2
- Mereckiene, J., Cotter, S., Nicoll, A., Levy-Bruhl, D., Ferro, A., Tridente, G., Zandoni, G., Berra, P., Salmaso, S., O'Flanagan, D. and O'Flanagan, D. (2008) 'National seasonal influenza vaccination survey in Europe, 2008', *Euro Surveillance* 13(43): pii=19017
- Mytton, O. T., Rutter, P. D. and Donaldson, L. J. (2012) 'Influenza A(H1N1) pdm09 in England, 2009 to 2011: a greater burden of severe illness in the year after the pandemic than in the pandemic year', *Euro Surveillance* 17(14): pii=20139
- National Archives (2009) 'UK to get pre-pandemic swine flu vaccine', 15 May. Accessed 12 August, 2011 from http://www.direct.gov.uk/en/Swineflu/News/DG_178226
- Nature editors (2010) 'Lessons from a pandemic', *Nature* 463(7278): 135-136
- Neustadt, R. E. and Fineberg, H. V. (1978) 'The Swine Flu Affair', Accessed 19 June, 2010 from <http://biotech.law.lsu.edu/cphl/history/books/sw/>
- Nicoll, A., Brown, C., Karcher, F., Penttinen, P., Heggermann-Lindencrone, M., Villanueva, S., Ciotti, M., Jean-Gilles, L., Rehmet, S. and Nguyen-Van-Tam, J. S. (2012) 'Developing pandemic preparedness in Europe in the 21st century: experience, evolution and next steps', *Bulletin of the World Health Organization* 90.4: 245-320
- Open Briefing (2011) 'Biota Holdings Limited (BTA) - CEO on Outlook, LANI Potential', 16 February. Accessed 4 February, 2012 from <http://www.openbriefing.com/OB/Biota-Holdings-Limited/2011/2/16/CEO-on-Outlook--LANI-Potential/319.aspx>
- Osterholm, M. T., Kelley, N. S., Sommer, A. and Belongia, E. A. (2012) 'Efficacy and effectiveness of influenza vaccines: a systematic review and meta-analysis', *The Lancet Infectious Diseases* 12.1: 36-44

- Pew Commission on Industrial Farm Animal Production (2008) 'Putting meat on the table: industrial farm animal production in America', Accessed 6 February, 2012 from http://www.ncifap.org/_images/PCIFAPSmry.pdf
- Philidor, D. (2009) 'Swine Flu Or Mexican Influenza?', 29 April. Accessed 21 August, 2011 from <http://ezinearticles.com/?Swine-Flu-Or-Mexican-Influenza?&id=2286980>
- President's Council of Advisors on Science and Technology [PCAST] (2009) *Report to the President of U.S. Preparations for 2009 H1N1 Influenza*, Washington DC: White House Office of Science and Technology Policy
- PREVENT Project (2011) 'Beyond pandemics: A whole-of-society approach to disaster preparedness', Accessed 27 January, 2012 from http://www.towardsa saferworld.org/sites/default/files/tasw_booklet_final_11.28.11.pdf
- Relman, D. A., Choffnes, E. R., Mack, A. M. (rapporteurs) (2010) *The Domestic and International Impacts of the 2009-H1N1 Influenza A Pandemic: Global Challenges, Global Solutions: Workshop Summary*, Washington DC: The National Academies Press, Accessed 4 March, 2012 from http://www.nap.edu/catalog.php?record_id=12799
- Roche (2006) 'Tamiflu readily available for 2006/2007 influenza season', 2 October. Accessed 6 February, 2012 from <http://www.roche.com/med-cor-2006-10-02>
- Schwartz, N. D. (2005) 'Rumsfeld's growing stake in Tamiflu', *CNN Money*, 31 October. Accessed 9 February, 2012 from http://money.cnn.com/2005/10/31/news/newsmakers/fortune_rumsfeld/?cnn=yes
- Scoones, I. and Forster, P. (2008) *The International Response to Highly Pathogenic Avian Influenza: Science, Policy and Politics*, STEPS Working Paper 10, Brighton: STEPS Centre
- Sedyaningsih, E. R., Isfandari, S., Soendoro, T. and Supari, S. F. (2008) 'Towards mutual trust, transparency and equity in virus sharing mechanism: the avian influenza case of Indonesia', *Annals of the Academy of Medicine Singapore* 37.6: 482-488
- Smith, J. (2009) 'Point-by-point response from Roche to BMJ questions', *British Medical Journal* 339: b5374
- Smith, J., Lipsitch, M. and Almond, J. W. (2011) 'Vaccine production, distribution, access, and uptake', *The Lancet* 378.9789: 428-438
- Stolberg, S. G. (2009) 'Shortage of Vaccine Poses Political Test for Obama', *New York Times*, 28 October. Accessed 4 March, 2011 from http://www.nytimes.com/2009/10/29/us/politics/29shortage.html?_r=1
- Tadroz, M. (2010) 'Scapepigging: H1N1 Influenza in Egypt', in S. Dry and M. Leach (eds) *Epidemics: Science, Governance and Social Justice*, London: Earthscan: 213-238

- The Week (2010) 'Big pharma probed for 'false' swine flu pandemic', 11 January. Accessed 12 August, 2011 from <http://www.theweek.co.uk/politics/17419/big-pharma-probed-%E2%80%98false%E2%80%99-swine-flu-pandemic>
- Toovey, S., Rayner, C., Prinssen, E., Chu, T., Donner, B., Thakrar, B., Dutkowski, R., Hoffmann, G., Breidenbach, A., Lindemann, L., Carey, E., Boak, L., Gieschke, R., Sacks, S., Solsky, J., Small, I. and Reddy, D. (2008) 'Assessment of neuropsychiatric adverse events in influenza patients treated with oseltamivir: a comprehensive review', *Drug Safety* 31.12: 1097-1114
- Trifonov, V., Khiabani, H., Greenbaum, B. and Rabadan, R. (2009) 'The origin of the recent swine influenza A(H1N1) virus infecting humans', *Euro Surveillance* 14.17: pii=19193
- UNAIDS (2009) 'Influenza A(H1N1) and HIV infection', Accessed 5 May, 2012 from <http://www.unaids.org/en/resources/presscentre/featurestories/2009/may/20090501ah1n1>
- Van Zwanenberg, P. and Millstone, E. (2005) *BSE: risk, science and governance*, Oxford: Oxford University Press
- Wald, P. (2008) *Contagious: Cultures, Carriers, And The Outbreak Narrative*, Durham, NC: Duke University Press
- Wallace, R. (2009) 'The NAFTA flu', *Socialist Worker*, 1 May. Accessed 20 August, 2011 from <http://socialistworker.org/2009/05/01/the-nafta-flu>
- Walsh, B. (2009) 'H1N1 Virus: The First Legal Action Targets a Pig Farm', *Time*, 15 May. Accessed 22 August, 2011 from <http://www.time.com/time/health/article/0,8599,1898977,00.html#ixzz1rhpBHRjS>
- Webster, R. G. and Hulse, D. J. (2004) 'Microbial adaptation and change: avian influenza', *Revue Scientifique et Technique* 23.2: 453-465
- White, S. W., Petersen, R. W. and Quinlivan, J. A. (2010) 'Pandemic (H1N1) 2009 influenza vaccine uptake in pregnant women entering the 2010 influenza season in Western Australia', *The Medical Journal of Australia* 193.7: 405-407
- World Health Organization [WHO] (1999) 'Influenza pandemic plan. The role of WHO and guidelines for national and regional planning', Geneva, Switzerland
- (2006) 'Constitution of the World Health Organization', Accessed 4 August, 2011 from http://www.who.int/governance/eb/who_constitution_en.pdf
- (2009a) 'Pandemic (H1N1) 2009 briefing note 20', 22 December. Accessed 17 August, 2011 from http://www.who.int/csr/disease/swineflu/notes/briefing_20091222/en/
- (2009b) 'Influenza A(H1N1) - update 46', 10 June. Accessed 10 August, 2011 from http://www.who.int/csr/don/2009_06_10a/en/index.html
- (2009c) 'Pandemic (H1N1) 2009 briefing note 3 (revised)', 16 July.

- Accessed 18 August, 2011 from http://www.who.int/csr/disease/swineflu/notes/h1n1_surveillance_20090710/en/index.html
- (2009d) 'Pandemic (H1N1) 2009 briefing note 11', 24 September. Accessed 9 February, 2012 from http://www.who.int/csr/disease/swineflu/notes/pandemic_influenza_vaccines_20090924/en/index.html
 - (2009e) 'Influenza A(H1N1) - update 5', 29 April. Accessed 11 November, 2010 from http://www.who.int/csr/don/2009_04_29/en/index.html
 - (2009f) 'Influenza-like illness in the United States and Mexico', 24 April. Accessed 19 August, 2011 from http://www.who.int/csr/don/2009_04_24/en/index.html
 - (2009g) 'World now at the start of 2009 influenza pandemic', 11 June. Accessed 2010, 29 July from http://www.who.int/mediacentre/news/statements/2009/h1n1_pandemic_phase6_20090611/en/index.html
 - (2010a) 'Pandemic (H1N1) 2009 - update 112', 6 August. Accessed 11 August, 2011 from http://www.who.int/csr/don/2010_08_06/en/index.html
 - (2010b) 'Seroepidemiological studies of pandemic influenza A(H1N1) 2009 virus', *Weekly Epidemiological Record* 24.85: 229-236
 - (2010c) 'WHO Director-General declares H1N1 pandemic over', 10 August. Accessed 10 August, 2011 from <http://www.euro.who.int/en/what-we-do/health-topics/communicable-diseases/influenza/news/news/2010/08/who-director-general-declares-h1n1-pandemic-over>
 - (2010d) 'Pandemic (H1N1) 2009 - update 108', 9 July. Accessed 10 August, 2011 from http://www.who.int/csr/don/2010_07_09/en/index.html
 - (2010e) 'Transcript of virtual press conference with Dr Keiji Fukuda, Special Adviser to the Director-General on Pandemic Influenza, World Health Organization', 14 January. Accessed 19 August, 2011 from http://www.who.int/mediacentre/vpc/transcript_14_january_10_fukuda.pdf
 - (2010f) 'Statement by Dr Keiji Fukuda on behalf of WHO at the Council of Europe hearing on pandemic (H1N1) 2009', 25 January. Accessed 19 August, 2011 from http://assembly.coe.int/CommitteeDocs/2010/20100125_Hearing_E.pdf
 - (2010g) 'WHO Director-General's letter to BMJ editors', 8 June. Accessed 20 August, 2011 from http://www.who.int/mediacentre/news/statements/2010/letter_bmj_20100608/en/index.html
 - (2011a) 'Summary of WHO Technical Consultation: H1N1pdm Mortality Estimates, 25-26 October 2011', Accessed 9 February, 2012 from http://www.who.int/influenza/publications/surveillance_monitoring/H1N1pdmMortalityEstimates_WHOconsultation.pdf
 - (2011b) 'Report of the Review Committee on the Functioning of the International Health Regulations (2005) in relation to Pandemic (H1N1) 2009', Accessed 22 August, 2011 from http://apps.who.int/gb/ebwha/pdf_

files/WHA64/A64_10-en.pdf

— (2012) Report of the second WHO Consultation on the Global Action Plan for Influenza Vaccines (GAP) 12–14 July 2011, Geneva, Switzerland

— (undated) 'Ten things you need to do to implement the IHR', Accessed 19 February, 2012 from <http://www.who.int/ihr/about/10things/en/index.html>

World Health Organization Writing Group (2006) 'Nonpharmaceutical interventions for pandemic influenza, national and community measures', *Emerging Infectious Diseases* January Accessed 9 February, 2012 from http://wwwnc.cdc.gov/eid/article/12/1/05-1371_article.htm

World Organisation for Animal Health [OIE] (2009) 'OIE position on safety of international trade of pigs and products of pig origin', 28 April. Accessed 24 August, 2011 from <http://www.oie.int/for-the-media/press-releases/detail/article/oie-position-on-safety-of-international-trade-of-pigs-and-products-of-pig-origin>

Wuethrich, B. (2003) 'Chasing the Fickle Swine Flu', *Science* 299.5612: 1502–1505

Wynne, B. (1992) 'May the Sheep Safely Graze? A Reflexive View of the Expert-Lay Knowledge Divide', in S. Lash (ed) *Risk, Environment & Modernity*, London: Sage Publications: 44–83

Yamada, T. (2009) 'Poverty, Wealth, and Access to Pandemic Influenza Vaccines', *New England Journal of Medicine* 361.12: 1129–1131

Zacks Investment Research (2009) 'Swine Flu Impact On Anti-Viral Sales - Use of Tamiflu And Relenza Will Come From Stockpiles', 27 April. Accessed 7 February, 2012 from <http://www.dailymarkets.com/stock/2009/04/27/swine-flu-impact-on-anti-viral-sales-use-of-tamiflu-and-relenza-will-come-from-stockpiles/>